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PHYSIOLOGY
FOR
COMMON SCHOOLS.

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PHYSIOLOGY.

FOR COMMON SCHOOLS,

IN TWENTY-SEVEN EASY LESSONS,

BY MRS. CHARLES BRAY.

"We are satisfied that much of the sickness from which the working-classes at present suffer might be avoided; and we know that the best-directed efforts to benefit them by medical treatment are often greatly impeded, and sometimes entirely frustrated, by their ignorance and their neglect of the conditions upon which health necessarily depends. We are therefore of opinion that it would greatly tend to prevent sickness, and to promote soundness of body and mind, were the elements of Physiology, in its application to the preservation of health, made a part of general education; and we are convinced that such instruction may be rendered most interesting to the young, and may be communicated to them with the utmost facility and propriety in the ordinary schools by properly-instructed schoolmasters."—*Medical Opinion of 65 of the leading Physicians and Surgeons of London, on the importance of teaching the Laws of Health in Common Schools. London, March, 1853.*

LONDON :

LONGMAN, GREEN, LONGMAN, AND ROBERTS.

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PREFACE.

THIS small work is chiefly intended as a lesson-book for our common schools, and is an attempt to make intelligible to the children of the poorer classes so much of the nature of the vital organs and functions as shall give them some correct ideas with respect to the means by which disease may be avoided and health preserved. Instruction in the first principles of Physiology and the Laws of Health has been now recognised as appropriate to schools of this kind, and some admirable works have been published for the purpose of conveying it; but apparently none yet have been produced sufficiently simple and elementary to really suit the capacities of the majority of the children who attend: either more is explained of the complicated vital organism than is necessary for the purpose, or it is explained by means of the usual technical terms which leave only a confused and tedious impression on young untutored brains quite new to the subject. In manufacturing towns, where it would be especially desirable to give such instruction to the future wives and mothers of operatives, the girls are often taken from school at an early age, and before the mind is equal to the reception of any knowledge except of the very plainest kind. And yet these few years at school, before they enter upon the destined work of their lives, in factories, workshops, or busy homes, may be their best and even only opportunity of gaining a few sound ideas on the subject of health for future guidance. As an occasional visitor at girls' schools of this class, I have had

some opportunities of making the experiment whether lessons on a few of the leading physiological facts, made as easy as the nature of the subject would admit, and illustrated by a few large diagrams, might not form a useful variety to the ordinary school-tasks. There could be no doubt as to the interest these lessons excited, and there was always sufficient comprehension on the part of some of the scholars to make me wish for some class-book to leave in the teachers' hands by means of which the lessons could be often repeated and the little knowledge so gained be made permanent. This wish gave rise to the present attempt; and it is hoped that in the hands of any teachers ~~ordinarily~~ qualified, and with the aid of a few good school diagrams, this little work may help to familiarise the children of that class necessarily most exposed to the casualties of disease, with the knowledge of the best natural preventive means. Of course an intelligent instructor will know how to illustrate and expand these brief lessons according to the capacity of the pupils. It is to be understood that the *questions* and *answers* are not intended to be learned by rote by the children, but are merely to assist the teacher to perceive the chief points to be enforced in the lesson.

The writer cannot help hoping that the use of these pages may not be entirely confined to Schools; but that they may serve some good purpose in other quarters, where knowledge of this kind might be valued if it were given in a brief and easy form. There are still a few specimens left of the class to which the old woman belonged who was afflicted with "a rising of her lights," and so "swallowed shot to keep them down;" and also the poor mother, who attributed the nervous maladies of her daughter to "the wind in the veins which blew the blood up into heaps, and so made a flockering in her inside;" and there are many more whom a little better knowledge of the causes of disease would save

from much suffering; whose constant cure at present for all ills is the dram, the drug, and the pill, and for all cases of loss of appetite, "tid-bits;"—that is, something richer and more indigestible than ordinary food. Indeed, it is impossible to over-estimate the loss of health in the families of the poor from the physicking propensity,—from the many little victims of Godfrey's Cordial, to the sick child whose mother thought "he ought to be well, since she had given him all the physic that was left in the bottles at his grandfather's death;" and it is thought that the introduction into such families, through lending libraries and other means, of works on the laws of our constitution that do not repel by their length or abstruseness, might be one means of giving them faith in pure air, soap and water, wholesome diet, and temperate habits.

For school purposes, the diagrams that may be recommended as suitable for illustrating these Lessons, are either those published by *Johnston*, (*E. Stanford, 6, Charing-Cross*); or those by the Working Men's Educational Union, (*25, King William-Street, West, Strand.*)

C. B.

MARCH, 1860.

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PART FIRST.

LESSON 1.

THE CARE OF HEALTH IS ONE OF OUR DUTIES.

WE ought all to try to keep ourselves in good health as far as we are able, that we may fulfil well the duties of life; that we may rightly use and enjoy the blessings around us; and that we may be useful to others instead of being a burden to them. Few people can be very happy or very useful if they are sickly and diseased.

Everybody has some work to do in this world; no one is made to be idle. Some have to work with their hands, others have to work with their heads; but no kind of work is done well unless the body and mind be healthy.

Our bodies will not keep healthy of themselves any more than they will keep alive of themselves. We know that to keep ourselves alive we must take two things into our bodies,—food and air; but to keep ourselves healthy the food must be the right sort of food; the air must be pure air; we must be cleanly

and temperate ; we must have plenty of exercise in the day-time, and plenty of sleep at night.

If we understand the use of the different parts of our bodies,—such as the lungs, the heart, and the stomach,—we shall understand better what is good for them to keep them in order ; just as a man can take better care of his clock or watch if he understands the use of the different wheels, springs, and weights inside. A great many people fall ill and die every year because they do not know enough about their own bodies to prevent disease.

The illness of one person may lead to the illness of others ; thus if a child has small-pox it may spread the disease, and so be the cause of death to many. Or if a man catches a fever, he may infect others in his neighbourhood with it. The child might have escaped the disease if it had been vaccinated ; and the man might possibly have escaped the fever if he had known how to take care of his health ; and thus a little knowledge and care might have saved not only these two lives, but that of others.

We cannot be ill in any way without giving trouble to those with whom we live, and causing them expense and loss of time. For the sake of others then, as well as ourselves, we should try and learn how to avoid disease as much as we can.

We cannot prevent all sickness and disease ; but it is found that a great deal may be prevented when people learn to take care of their health in the right way.

Even children may learn and understand something of the wonderful structure of their bodies. When they grow older they can learn more; and the more they learn the more they will see of the goodness of Him who made us what we are; and the more they will feel that it is our duty to preserve and make a right use of His gift of Life.

Question. Is it right, for the sake of others as well as ourselves, that we should take care of our health?

Answer. Yes.

- Q.** What do we require to keep us alive?
- A.** Food and Air.
- Q.** What do we require to keep us healthy?
- A.** Wholesome food; good air; cleanliness; exercise; sleep.

LESSON 2.

WHY MUST WE TAKE FOOD?*

If you are asked, Why do you take food? you will answer, Because we are hungry, and we should starve if we did not.

But why are we hungry? And how is it that, if we were left without food, our bodies would grow

* In these first lessons it is only attempted to give a general idea of the processes of repair and waste; in subsequent lessons the subject is more fully explained.

thinner and thinner, all our flesh would go away, and soon we should be little else but skin and bone?

Where does the flesh go to? Does a wooden doll or a stone statue grow less and less if it is not fed?

The reason why we want food, and grow thinner if we do not have it, is because every part of a living body is constantly being used up to support Life; something in the same way as the coal in the grate is used up to support the fire.

The coal grows less and less as it keeps the fire alive, and the substance of our bodies grows less and less as it supports the Life within us.

If we neglect to put fresh coal on the fire, the fire gradually dies out; and if we did not take food, the life would become feebler and feebler as the body wasted away, and would at last go out for want of fresh nourishment; as the last spark in the grate goes out for want of fresh fuel.

If you could look inside your bodies you would see that there must be a constant wearing away of every part, because every part is in constant motion. Put your hand to your side, and you will feel your heart beat; put your finger to your wrist and you will feel your blood running along; and although the motion in some parts is too fine to be felt or seen, yet there is no rest anywhere in a living body, and change and motion go on always inside us, whether we are awake or asleep, whether we stand still or move about.

Now, wherever there is motion, there must be wear

and waste. In an engine or a loom the parts of the machinery are always wearing away by rubbing against each other ; and the faster they move the faster they wear away. It is the same in the living body ; the faster the motion of the parts, and the more we exert ourselves, and move our bodies and work our limbs, the faster the wear and waste goes on, and the more food is required to make up the loss.

We want, therefore, a certain quantity of food every day to keep the life within us. If the nourishment we take is equal to what our bodies waste away, then we have enough ; if it is less than our bodies lose, then we have not enough, and our health becomes weak and our strength less.

But the wearing away that goes on in a living body is not like the wearing away of machinery ; as was said before, it is more like the burning away of fuel in the fire. Part of the coal that has been burned and done with turns to gas and goes up the chimney ; in something like the same manner, the parts of our body that have given out their nourishment and are done with, turn to Breath and Perspiration, and go off from our bodies.

The Breath comes away out of our mouth and nose ; the Perspiration comes away through the little holes or pores in the skin, which are too small to be seen except through a microscope, but which lie close together all over the surface of the body.

Q. Why must we take Food ?
 A. To repair the waste of the body.
 Q. What are the Perspiration and Breath ?
 A. Part of the waste matter that comes away from our bodies.
 Q. How does the Perspiration go off from the body ?
 A. Through the skin.
 Q. How does the Breath come away ?
 A. Through the mouth and nose.

LESSON 3.

WHY MUST WE WASH OURSELVES ?

THE Perspiration is always coming through our skins. Hold the tip of your finger very close to a piece of glass, but without touching the glass ; you will see the glass become dim and moist. That is because the perspiration has come out of your finger on to the glass.

•When we are very hot the perspiration comes very fast, and then we can see it quite plainly on the skin like drops of water.

The Perspiration is composed partly of water and partly of a greasy substance that remains on the skin after the watery part has dried off into the air. It is this greasy matter that makes our skin and clothes grow dirty of themselves, without our doing anything to make them dirty ; and unless we often wash our skin and change our clothes, we know that this dirt

becomes quite offensive, both to see and to smell. It is, besides, necessary for our health that the skin should be kept clean; for if the dirt remains on the skin, it clogs up the pores, and the skin cannot so well throw off the waste matter.

This waste matter is very injurious if it is left in the body; and people, therefore, who do not well wash themselves are more liable to catch colds and other diseases than those who are always clean. Some persons think themselves clean enough if they wash their hands and face every morning. But as the perspiration is always coming out through every part of the skin, nobody can be really clean who does not wash regularly the whole body.

- Q. Why must we wash ourselves and change our clothes?
- A. Because part of the perspiration remains on the skin and clothes, and makes them dirty.
- Q. Why does it injure the health if dirt is left on the skin?
- A. Because it prevents the skin from getting rid of the impure and waste matter.

LESSON 4.

WHY MUST WE KEEP OUR ROOMS WELL AIRED?

THE Breath is composed partly of water and partly of bad air.

The water you may easily see if you breathe upon

glass. The heat inside us turns the water into steam ; but the cold of the air soon turns it back again to water ; and so you find that by breathing on anything you make it wet.

The bad air in the breath cannot be seen, but it can be perceived plainly enough if a number of persons are shut up in a close room where there are no windows and doors open to let the bad air go out and the fresh air come in.

In such a room the people soon begin to feel faint and uncomfortable, because they have to breathe again part of the bad air which they have just breathed out, and also the impure matter of the breath. If a man were shut up in a box he would die in a few minutes because the box would become so full of his breath that he would have to breathe it over again with scarcely any fresh air being mixed with it.

About ten years ago some people who were coming over from Ireland to Liverpool in a steam-packet lost their lives entirely because the captain of the vessel did not consider how dangerous it is to breathe the breath over again. As the captain saw that a storm was coming on he ordered all the passengers to go below into the cabin. Now this cabin was much too small for all the persons that were crowded into it, and when they were all down, the captain thoughtlessly ordered the hatches, or openings at the top, to be fastened down and the entrance to be close shut. Of course no fresh air could get in, and so the poor passengers had to

breathe over and over again the same air. Their sufferings were dreadful, and they tried all they could to get out. At last one of them forced his way up to the deck and told the mate how the passengers were being suffocated. When the mate went down, he found that seventy-two were dead, and many were dying. Those who survived had fever.

The rooms we live in are fortunately never made so air-tight as this cabin, and the fresh air from outside is sure to find its way through crevices at the doors and windows or down the chimnies; but still a room in which people have been breathing a long time can never be made quite wholesome unless doors and windows are often opened wide to let the bad air out and the fresh air in.

A fire in the grate helps to change the air: but in bed-rooms where there is no fire, and we shut out every draught of air that we may keep ourselves warm while we sleep, the air becomes very bad before morning, and the bed-clothes also become full of the animal matter that has come through our skins.

As soon, therefore, as we are dressed in the morning, we should open the windows wide, and turn the bed-clothes back, so as to expose them well to the fresh air before the bed is made up again.

When we are out in the open air our breath is so immediately carried away and mixed up with the fresh air in the sky above that there is no danger of our breathing it over again. And this is one of the reasons

why it is so healthy for us to be a great deal in the open air. People whose work is chiefly out of doors are generally more healthy than those whose work is in close rooms.

Q. What is the Breath composed of?

A. Partly water, and partly air that is unfit to breathe, and mixed with animal matter.

Q. Why should we often let fresh air into the rooms in which we live?

A. Because this bad air from our breath mixes with the air in the room, and makes it unwholesome to breathe.

LESSON 5.

HOW IS THE WHOLE OF THE BODY FED?

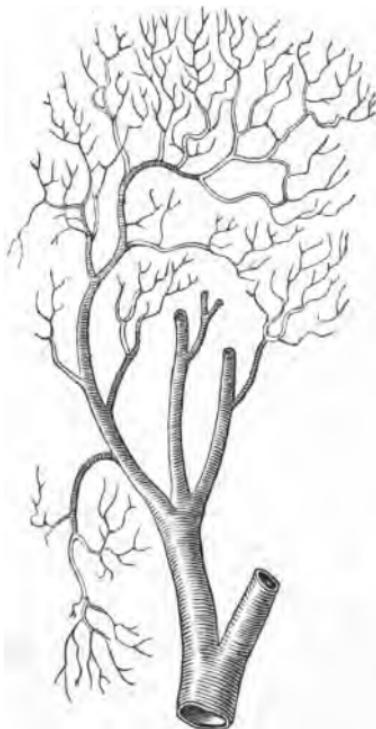
SINCE every part of our body is constantly wasting away, every part must constantly be fed with fresh substance, or else it would wither and die.

But how does taking food into the stomach feed every part of the body? And how does eating two or three meals a day keep the whole of our body constantly fed?

You know that when you prick or cut any part of the body, the blood flows; but perhaps you did not know that that blood contains part of the food that you have lately eaten; part of the bread and milk you had at breakfast, or of the meat and potatoes you had at dinner. Before the food that we eat can feed us, it has to be turned into blood, which runs in all directions

through our bodies along small tubes called blood-vessels, feeding every part as it runs along.

These blood-vessels are of two kinds, Veins and Arteries. They branch off from main trunks in the middle of the body into smaller and smaller tubes, as a tree branches off into boughs and twigs, until at last they end in a net-work of vessels so small and fine as to be almost invisible.



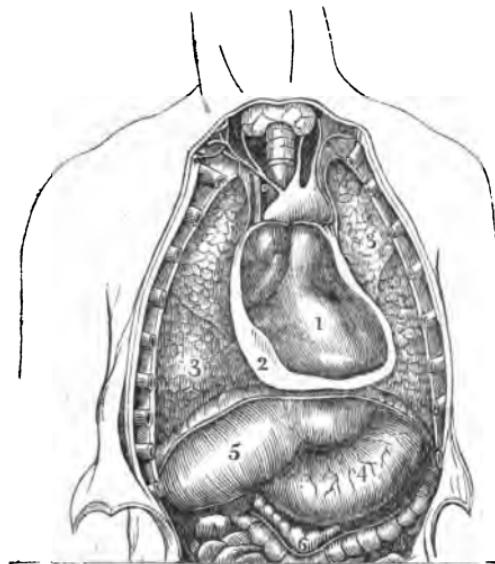
BRANCH OF AN ARTERY.

Here is a picture of the branch of an Artery. You

can see the branch of a Vein by looking at the back of your hand.

We can partly understand the way in which food is changed into so fine a fluid that it can run easily through these small vessels ; and if we could look inside our bodies we might partly see the wonderful apparatus by which it is done.

INSIDE OF THE BODY.



- 1 Heart.
- 2 Bag inclosing the Heart.
- 3 Lunga.
- 4 Stomach.
- 5 Liver.
- 6 Intestines.

Here is a picture of the inside of a human body. You see that it contains many parts of different shape

and size. But although they are all so different, they all help to do the same work : that is, To make the blood that feeds us out of the food that we eat.

Thus the mouth, the stomach, and the lungs, and other parts of the body, are constantly employed in helping to change the food into blood ; and each has its own share of the work to perform.

First, the mouth has to receive the food, and to prepare it for the stomach by making it into a pulp that can easily be swallowed and digested. This it does by means of the Teeth and Jaws, the Tongue, and the moisture in the mouth called the Saliva.

Q. How does the food we eat feed us ?
A. By being turned into blood, and so running through every part of the body.
Q. What does the blood run along ?
A. Arteries and veins.

LESSON 6.

THE TEETH.

THE Teeth are hard little instruments, made exactly of the shape and size that are best for cutting, tearing, and grinding the food. They are 32 in number ; that is, 16 in the upper jaw, and 16 in the lower.

There are four different sorts of teeth.

First, in the front of the mouth there are the eight Cutting Teeth, four at the top and four at the bottom. These we *bite* with. See 1 and 2.

Next to these come the four pointed, or Dog-Teeth, one on each side of each jaw. They are used for *tearing* the kinds of food that cannot be bitten, such as meat, and other tough substances. They are called dog-teeth, because the dog, which is a flesh-eating animal, has most of its teeth pointed. See 3.

Next are eight teeth called *Bi-cuspids*, which means, having two points. These are used both for *tearing* and *grinding*. There are two on each side of each jaw. 4 and 5.

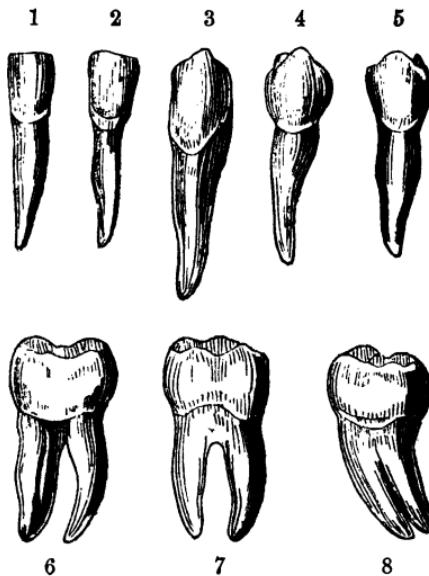
Then come the strongest teeth in the head, the Grinders. These are twelve in number, three on each side of each jaw. They are admirably fitted for breaking hard things,—as you know when you crack nuts with them,—by their large size, by the firmness with which they are fixed in the jaw by means of several strong fangs or roots, and by their uneven surfaces, which enable them to grind much better than if they were smooth. 6, 7, 8.

It is curious to see how the uneven surface of the upper teeth fits in to the uneven surface of the lower; so that the food that passes between them may be ground as fine as possible.

The bone of which the teeth is formed is much harder than common bone; and to prevent them wear-

ing away as they rub against each other, the part above the gum is covered with an exceedingly hard and smooth substance, called Enamel.

TEETH ON ONE SIDE OF THE LOWER JAW.



1—2 Cutting Teeth.

3 Dog Tooth.

4—5 Bi-cuspids.

6—7—8 Grinders.

The Enamel has no feeling in it, but the inside of the tooth has feeling; if therefore the enamel did not cover them, we should feel pain in our teeth every time we used them.

Children who crack nuts and other hard things

with their teeth without taking sufficient care, sometimes chip off little bits of this enamel without knowing it ; then the air getting to the bone soon makes it decay, and the tooth will begin to ache.

The Enamel is liable to decay if it is not kept perfectly clean. Any little bits of food left sticking about our teeth soon become putrid and eat into the Enamel just as rust eats into iron ; then, when the Enamel is gone, the rest of the tooth soon decays, and we have to suffer the dreadful pain of tooth-ache as well as losing our teeth.

If you had a beautiful knife or pair of scissors given to you, should not you think yourself very foolish if you let them get spoiled with rust for want of wiping them clean after you had used them ? We are much more foolish if we neglect to wash and brush and keep quite clean this nice case of instruments that has been given us for our use and health and comfort every day of our lives. The knives and forks that we use at dinner we know ought always to be washed well afterwards ; but it is worse even than putting away the knives and forks dirty to leave dirty these living implements in our mouths.

The teeth should be well cleaned with a tooth-brush and water every night before going to bed, and again in the morning ; at any rate, every morning. There is nothing so disgusting to look at as dirty teeth ; and besides they make the breath smell disagreeable. Children often destroy their teeth by constantly eating

unwholesome things, such as pastry and sweetmeats and unripe fruit. If too many of these are eaten, the stomach becomes disordered, and a disordered stomach usually makes the teeth rotten.

Many people suffer a great deal of pain from tooth-ache, and are sickly and ailing all their lives from the want of a good set of teeth to chew their food properly with, without in the least thinking that it has been their own fault for not taking proper care of their teeth when they were young.

The teeth are not all formed at the same time ; it is not until we are grown up that we have all our 32 teeth complete. The new-born infant has no teeth ; for the smooth soft gums are all that it needs to feed with, and hard teeth would be very much in its way. But as the child grows and requires solid food, the little white teeth begin to appear through the gums, and get larger and stronger as the child's food wants stronger teeth to chew it with ; and when childhood is passed, the first small teeth come out and give place to still stronger ones which are to remain through life.

This suiting the teeth to the food is one of the many, many instances that we can see of the care of the Great Father for the comfort and health of His children—even for the helpless babes ; a care more wise and tender than that of the kindest mother. The pain that we suffer when we do not make a proper use of the means that He has given us for our health and comfort, is the warning voice that tells us we have done wrong.

We see that this same care has been taken for all other animals as well as man, in the different forms of their teeth. Thus, dogs and cats and lions and all animals that feed on flesh, have their tearing and grinding teeth very large and strong ; horses and cows and all such as feed on grass or grains, have chiefly cutting and grinding teeth ; while rats and rabbits and those that gnaw their food, have mostly long cutting-teeth and grinders. Man, who lives on many kinds of food, has a greater variety of teeth than any other animal.

Q. Why ought we to take care of our teeth ?

A. Because the food ought to be well chewed before it is swallowed.

Q. How can we best take care of our teeth ?

A. By brushing them regularly, and by eating wholesome food.

LESSON 7.

THE JAWS AND TONGUE.

THE contrivance by which the teeth are fastened in the jaws is very perfect. All along the edge of each jaw is a bony arch with a row of holes in it. The roots or fangs of the teeth are fixed firmly in these socket-holes, and as each socket exactly fits the tooth

that grows into it, it holds it as fast as a nail is held when driven into a board. The gums also help to fix the teeth in their places, and protect the neck of the tooth between the socket and the enamel.

The upper jaw is fixed, and cannot move unless the head moves ; but the lower jaw is fastened to the head by hinges and joints that allow it to move either upwards or downwards, backwards and forwards, or sideways.

By these motions the under teeth are rubbed against the upper teeth in all ways that are necessary to chew the food well between them.

THE TONGUE.

There is perhaps no part of the human body more wonderful than the Tongue ; and it would take a long time to describe well all the clever things that this small lump of red flesh is able to perform. We all know that we could not talk without our tongue ; and it helps us in eating quite as much.

Take notice when you are eating how extremely active and busy the tongue is ; how it darts about from side to side, and changes its shape every instant. It helps the teeth to chew by pushing about the food under the different sorts of teeth, bruising the softer parts of the food against the palate or roof of the mouth, and mixing it well with the saliva, or moisture in the mouth. If we had no tongue to help in eating,

our jaws would ache terribly, long before we had eaten enough to satisfy our hunger ; and without the tongue we should find it almost impossible to swallow our food ; for the tongue collects together the food when it is chewed, and pushes it down towards the opening of the throat.

All these useful things the tongue is able to do by the quickness of its motions, and by its wonderful power of changing its shape in an instant ; at one moment darting out the tip and making itself long and narrow,—then drawing in the tip and making itself short and broad,—now curving itself up into something like a spoon, and then rolling itself backward ; and with all this quick motion taking such good care of itself that it seldom gets a bite from any of the teeth.

But the most wonderful faculty the tongue has is that of *taste*. Nobody has yet been able to discover how it is that the tongue has this power, and why this little piece of flesh, more than any other in the body, should be able to tell us that a thing is sweet or bitter, sour, or savoury, or pungent. All we can understand about it is, that the sense of taste has been given us for our enjoyment, and to make eating a great pleasure to us instead of a great trouble. Only think what weary work it would be if we had to force food down our throats two or three times every day without having any pleasure in doing it ! Many of us would neglect to eat at proper times, and would perhaps grow weak and ill, rather than take the trouble.

Other parts of the mouth have some sense of taste, but it is not nearly so perfect as in the tongue.

The tongue, with its delicate feeling of taste, often prevents our swallowing what would injure the stomach: for things that are poisonous and not fit for food, have mostly a disagreeable taste; while fruit, and bread, and meat, and milk, and vegetables, and all things that are good and wholesome for food have been made to taste pleasant.

- Q. What is the use of the Jaws?
- A. To hold the teeth firm, and to enable them to chew the food by rubbing the lower teeth against the upper.
- Q. Which jaw is moveable?
- A. The lower jaw.
- Q. What is the use of the Tongue?
- A. To taste with, to receive the food, to push it about under the teeth, to help break it up, and to push it towards the back of the throat when it is ready to be swallowed; and to help to talk with.

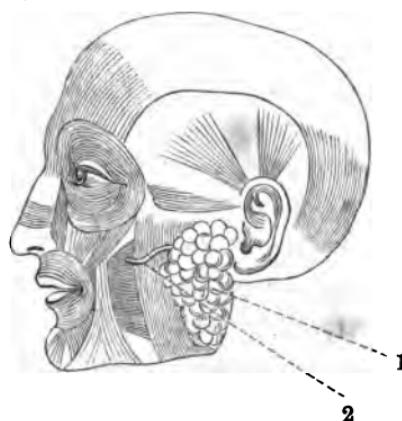
LESSON 8.

THE SALIVA.

THE food could not be chewed properly and made fit for digesting in the stomach unless it were well moistened and mixed with a fluid called Saliva.

Anybody who has been ill with a fever knows what it is to suffer from a dry or parched mouth, and how

almost impossible it is to eat when the mouth is in that dry state. Now, our mouths would be always in this dry, uncomfortable state if it were not for a number of most curious substances called Glands, which lie underneath the skin in the cheeks, and tongue, and gums, and lips, and palate, and which are constantly producing a fluid that pours into the mouth through a little tube or duct. When we are not eating, the saliva comes only in small quantities, just enough to keep the mouth comfortably moist; but directly we begin to eat, and want a large supply to mix with the food, the glands make the saliva much faster, and pour into the mouth a much larger quantity;—about half a pint sometimes, it is said, to a single meal.



**FACE WITHOUT THE SKIN, SHEWING THE GLAND IN THE CHEEK, (1),
AND THE DUCT, (2,) THROUGH WHICH THE SALIVA FLOWS INTO
THE MOUTH.**

We see, then, how well the mouth has been provided with the means of turning the food into a soft, pulpy mass ; which is the first part of the strange work of turning it into blood.

But it depends upon ourselves whether the work is done well. If we eat and swallow our food too fast, and put too much into our mouths at once, and do not chew it well, it will not digest easily, and we shall sooner or later suffer for it.

SWALLOWING THE FOOD.

The food passes down into the stomach through a tube called the gullet, which is placed at the back of the throat.

The food does not *drop* down the gullet by its own weight, but it is pushed along it by a peculiar motion in the gullet itself; (something like the motion of the skin of a worm's body when it is crawling.) If the food dropped down by its own weight, we should have to hold up our heads every time we swallowed ; and animals that always feed with their heads downwards, would find it difficult to get their food into their stomach at all, as they have to swallow up instead of down. The gullet is made to push along the food slowly and gradually, and a small quantity at a time ; and if we try to swallow too much at once and too fast, the motion of the gullet becomes too violent, and gives a sharp pain or spasm.

It seems such an easy thing to eat and to swallow, that no one who had not been told would imagine the care that had been required in the formation of the throat to enable us to do this with safety. But the truth is that unless this care had been taken, we should be in danger of instant death every time food passed down our throat. The danger is this: that another hollow tube, besides the gullet, opens into the back of the mouth,—for you know that it is as necessary to breathe air into our lungs as it is to take food into our stomach,—and this other tube, or Wind-pipe, is therefore provided for the air to go down. The Wind-pipe is placed at the front of the throat, and it opens into the mouth just where the food has to pass over before it reaches the opening of the gullet. Now, if the food were to slip down the wind-pipe instead of the gullet, and could not be immediately dislodged, we should be choked, and nothing could save us from death.

But to guard against this danger there has been placed at the opening of the windpipe a small flap, or lid of flesh, called the Epiglottis, which the moment the food is passing, shuts down and closes over the wind-pipe; and the moment the food has gone over it, it opens again to admit the air.

Sometimes, if we talk or laugh while we are eating, the Epiglottis is forced partly open just at the wrong time, and a little crumb may chance to slip into the wind-pipe. Fortunately, directly this happens, we are

able to cough violently, and can generally force it up again ; but the spasm and the pain this little crumb gives us shows us what we might suffer if this passage were not well guarded, and if all our food were liable to go down the wrong way.

- Q. What is the use of the Saliva ?
- A. To moisten the food while we chew it, and turn it into a pulp.
- Q. Where does the Saliva come from ?
- A. From the Glands.
- Q. What is the tube called through which the food goes down into the stomach ?
- A. The Gullet.
- Q. Where is it placed ?
- A. At the back of the throat.
- Q. What tube is placed in front of the throat ?
- A. The Wind-pipe.
- Q. Why does not the food go down the Wind-pipe ?
- A. Because the Epiglottis shuts down over the opening to it when food is passing.
- Q. Why should not we talk and laugh when we are eating ?
- A. Because that opens the Epiglottis, and may let the food drop into the Wind-pipe.
- Q. Why must not we eat and swallow fast ?
- A. Because the Gullet is made to push the food down slowly, and because the food must be well chewed and mixed with Saliva for it to digest.

LESSON 9.

DIGESTING THE FOOD.

As soon as the food has entered the stomach, the work of digesting it begins.

To digest the food is to separate from it the nutritious part and to change it into a fluid that can be made into blood.

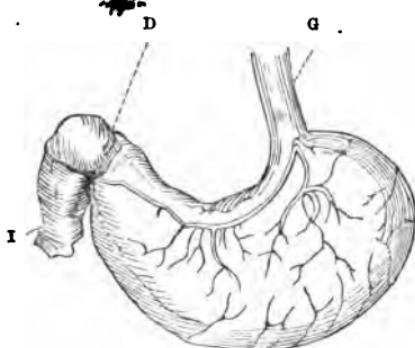
Bread and meat and pudding could not run along the arteries and feed the body, even if they were chewed ever so fine ; because a great portion of everything that we eat is not nutritive, and would clog up the body instead of feeding it. This waste part of the food has therefore to be carried out of the body through the bowels ; while the nourishing part, after it has gone through many changes, and had some things added to it, becomes the living or *vital* fluid called Blood.

Can anything be more wonderful than that dead flesh and dead vegetables, and water and bread, and substances that have no life in themselves, should, when once taken into our body, turn into living flesh, living bone, living skin ! And is it not also most wonderful that all the different kinds of food that we eat,—whether it is a piece of beef or a piece of bread ; whether it is a cupful of milk or a handful of gooseberries—all turn into just the same kind of living fluid ! The piece of beef contains much *more* nourishment than the gooseberries ; but exactly the same kind of blood is made from both.

The stomach begins the work of digestion by changing the food into a grey-coloured, pulpy substance called Chyme.

The stomach looks something like a large leathern bottle with two openings ; one for the food to come in

at down the gullet, (G) and the other for the digested food or chyme to go out into the intestines, (D). The stomach of a man ~~will~~ hold about three pints.



STOMACH WHEN FILLED.

Directly the food enters the stomach, a fluid called Gastric-juice is poured into it from the glands that lie under the skin, just in the same way as the saliva is poured into the mouth.

But the gastric-juice is quite a different fluid from the saliva, and has the power of dissolving the food into the grey paste called chyme. Whatever kind of food it is, or whatever its colour may be, the gastric-juice makes it all into much the same grey-coloured chyme.

Anything that the gastric-juice cannot dissolve into chyme cannot be made into blood, and is not proper food for us. Thus if we were to fill our stomachs with gravel or sawdust, it would not turn into chyme, and could not therefore feed us.

It is not what we eat, therefore, but what we digest, that really feeds us.

Wholesome food is that which easily and quickly turns into chyme; and which contains most of the kind of nourishment that is wanted for the blood. Unwholesome food is that which gives the stomach a great deal of trouble to dissolve, and has little nourishment in it.

Some people are foolish enough to play tricks with their stomach by swallowing things that cannot possibly digest. Thus some men have been known, for a wager, to swallow knives and stones. One little girl was fond of eating pieces of coal; another girl was known to swallow nails and pins; and many silly children for the sake of eating something, or of making their companions wonder, will cram themselves with trash that can only give the stomach a great deal of trouble without feeding them at all.

Of course the stomach will not long bear this ill-usage. Whatever is put into it that will not digest, must injure and weaken it; and if such tricks are played often, it will soon lose the power of digesting even wholesome food;—and then there is an end to health and comfort.

Food that will suit one person will not always suit another; but most healthy persons in this country find that they can digest with comfort such things as bread, meat, cooked vegetables, ripe fruit, eggs, milk, rice, &c. Such things therefore may be called wholesome

food, and it is well for those who can have every day enough of these to satisfy hunger.

But there are few people who can eat much of such things as raw vegetables, unripe fruit, heavy pastry, hot-buttered muffins, rich cakes, sweetmeats made of half chalk, or drink much spirituous liquors, without finding themselves the worse for it. Such things may therefore be called unwholesome food. We should take care then that the chief part of our food is of the wholesome kind ; and if we do sometimes eat the unwholesome things, it should be only in small quantities.

If the stomach is well treated, it does its work with wonderful regularity and cleverness. It makes the gastric-juice as fast as it is wanted, and as much as is wanted, to dissolve the food. If we eat only a little, only a little gastric-juice is made ; if we eat a hearty meal, a large quantity is made ; some kinds of food require more gastric-juice than others to digest them, and when we eat such, more is made.

But if we eat *more* than is good for us, and more than we want to satisfy our hunger, and fill our stomach too full, the stomach refuses to turn it into chyme, and no more gastric-juice is made. And then part of the food remains for some time undigested, and turns to wind or acid, and causes sickness, or the uneasy feeling that is called indigestion.

It is perhaps a good thing that some pain or uneasiness comes to give us notice when we have had

enough, or many of us who have plenty of food to eat, might go on over-eating till we destroyed the power of the stomach to digest at all.

If we only half chew our food, and send it down in great pieces, we injure the stomach by giving it more than its share of work to do ; for it has then to break up the food before it begins to dissolve it, and the digestion will take longer time, and be more difficult in consequence.

- Q. What is the use of the Stomach ?
A. To turn the food into Chyme, by means of the Gastric-juice.
- Q. What food is the most wholesome ?
A. That which digests easily, and contains the kind of nourishment that is wanted to make the blood.
- Q. What is the harm of eating unwholesome things ?
A. Besides the pain and illness it often causes, the stomach is injured by the effort it makes to digest them.

LESSON 10.

MOTION OF THE STOMACH.

DIRECTLY the food is swallowed, some curious things take place in the stomach, besides the pouring in of the gastric-juice.

When we have not taken food for some hours the sides of the stomach lie loosely together, like an empty

bag ; but as soon as we begin to eat, the sides or coats of the stomach stretch themselves out to make room for the food, and begin to move gently with a waving motion, which carries the food round and round, as if it were being churned.

This motion is slow and gentle at first, but gets faster and faster as digestion goes on.

The use of this churning motion is to mix the gastric-juice well with every part of the food ; just as you might shake up in a bottle any two things that you wanted to mix together.

But this curious motion not only mixes up the food with the gastric-juice ; it actually *arranges* the food, and separates that part of it which is quite turned into chyme from the part that is not yet turned ; and pushes the chyme to that side of the stomach where there is an opening into the intestine (D.) Look at the picture of the stomach, (page 27) and you will see the beginning of the long tube called the Intestines or Bowels (I).

All the food, as fast as it is turned to chyme, has to pass out of the stomach into the intestines ; but it would do us much mischief if it were to pass before it is digested : so to guard against this mischief, there is a valve at the opening, called the *Pylorus* or *door-keeper*, which is made in such a wonderful manner that any food trying to get through too soon, and before it is well digested, is sent back again, and only the chyme is allowed to pass.

Should not we think that carpenter very clever who had made a door that could open and shut of itself at the right times, and which let only the right sort of people go in, and pushed away the wrong ones?

This little valve or door-keeper inside us is quite as wonderful as such a door would be. For three or four hours after every meal it is guarding us from suffering, and perhaps from death, by letting only the soft chyme pass into the intestines, and by driving back the hard pieces of food till they are digested better.

If we are foolish enough to swallow anything that will not digest at all, this faithful door-keeper is obliged at last to let it go through, after sending it back over and over again; and then we have pain in the stomach and bowels for our punishment.

- Q. Where does the food go to when it has been digested in the stomach ?
- A. Into the Intestines.
- Q. What prevents it going into the Intestines before it is digested ?
- A. The valve called the Pylorus or door-keeper.

LESSON 11.

WHY IT IS BETTER TO EAT ONLY WHEN WE ARE HUNGRY.

WHEN we have eaten a good, hearty meal, it takes about four or five hours for it all to digest and pass out of the stomach; then when the stomach has been

empty and quiet for a little time, the feeling of hunger comes again to tell us that it is time to take some more food.

If we eat again before we are hungry, that is, before the stomach is empty, the fresh food going down and mixing with that which is half digested, disturbs the stomach and makes the digestion more difficult.

It is better, therefore, if we can, to eat a good meal at once, and then wait some hours ; and not to be constantly eating little bits and scraps.

Little children want feeding oftener than grown up people. They take less at a time, and they are hungry again sooner. But it is better for them to be kept from eating until they are hungry ; and it is a bad practice to be always giving them something to eat to amuse them and to keep them quiet, as some mothers and nurses do who do not like to take the trouble of keeping them good-tempered by better means.

By this constant eating, the child will lose its appetite for the proper meals ; its stomach will most likely become weak ; and it will be dainty about its food, and perhaps sickly and fretful, and so will give its mother a great deal more trouble in the end than if she had not spoilt it by this sort of over-indulgence.

A poor ragged beggar-woman, with a child in her arms, once begged at a house-door for something to eat, as she said her child was starving. The lady of the

house brought the child a piece of bread and butter ; but the child pushed it away and began to cry. The lady asked what was the matter. "Oh, ma'am," said the woman, "you see the poor darling never will eat bread and butter unless there's some sugar on it." The lady put some sugar on it, but she thought it a sad pity that a woman, who was obliged to beg her bread, had made her child so dainty.

- Q. What does Hunger come to tell us ?
- A. That the stomach is empty and it is time to take more food.
- Q. Why is it better to eat only when we are hungry ?
- A. Because the fresh food mixing with that which is partly turned to chyme disturbs the digestion.

LESSON 12.

WHAT IS THIRST?

THIRST is more terrible than hunger. If we had no food we might live for some weeks ; but if we had nothing to drink, and there were but little moisture in our food, we should most likely die in a few days. This is because our bodies are composed more of water than of anything else, and we therefore want more of water than of anything else to keep us alive.

Nearly three-quarters of the body is water; that is, if a man, weighing 100lbs., had all the water dried out of him, he would only weigh 30lbs. We know that every day several pounds' weight of this water goes off in the perspiration and breath; and when we do not take water enough to make up for this loss, the feeling of thirst comes to tell us that our bodies have too little water in them.

In hot weather we perspire more, and so want more to drink to make up the loss than in cold weather; and those men who are always in a heat and perspiration from their hard work, are much thirstier and want more to drink than people who can keep themselves cool.

It is not only by drinking water that we take water into our bodies. There is some water in all the food that we take. Bread, for instance, is nearly one-half water. Some fruits have so much water in them, that they quench the thirst almost the same as water; and all the liquids we take, such as milk, tea, beer, broth, are chiefly water.

We take in water also through our skins. If we were suffering very much from thirst, we should find that bathing would relieve us. The water would get in through the skin. We are constantly taking in moisture from the air through our skins.

You have heard people say: "The air is very damp to-day;" they mean by that that they can *feel* the water in the air. We can *see* it sometimes, when

it is in the form of mist or vapour ; but even when we cannot see or feel it, there is always some water or moisture in the air, and some of it is always being taken into our bodies through the skin.

In dry climates people suffer more from thirst, and have to drink more water than in moist climates like ours.

Since water is what we require when we feel thirsty, how foolish it seems to get the habit of quenching the thirst with beer or anything else, as some persons do.

Water is the safest and best drink for us all, if we take only just enough of it to satisfy the natural thirst ; and He who has made us, and knows what we need, has supplied the earth with abundance of this wholesome, refreshing, and beautiful sparkling fluid, good both for the outside and inside of our bodies.

People who are ill or weakly, may sometimes find that a little beer, wine, or spirits, does them good ; but such things always do more harm than good to persons who are healthy without them.

The natural thirst that we feel when there is too little water in our bodies can always be quenched by drinking water. But there is another kind of thirst that is not natural, and that no drinking can take away.

This is the kind of thirst that we have if we are ill of fever, when we long so much for water, and the water does us no good.

This is the kind of thirst the drunkard has ; and the more he drinks, the more thirsty he is.

This kind of thirst comes from disease, and not because the body requires more water; and the only way to take away this thirst is to cure the disease.

The habit of drinking spirits or too much beer produces this false thirst by disordering the stomach, and the best way to get rid of it is to stop drinking these heating fluids, and to restore the health of the stomach by wholesome food and cooling drinks.

Can there be a greater madness than to inflame the blood, destroy the health, and ruin the soul by drinking this gin or rum or brandy? as we see some poor foolish men and women do, who thus waste their money in making misery, when they might spend it in making comfort.

The man who goes into the public-house when he feels thirsty often comes out as thirsty as he went in, and with less money in his pocket; but if he goes to the pump instead, he loses his thirst and keeps his money.

The habit of drinking beer instead of water is often begun in childhood. Children do not often like beer at first, because it is not their natural drink, but they soon learn to like it, and get a habit of drinking it which is very difficult to break themselves of.

If children would remember that water is always better for them than beer if they are in good health, and if they would always refuse to drink beer even if it is offered them, they might save themselves from forming a bad habit which may be the curse of their future lives.

The reeling drunkard who starves his wife and children at home that he may buy more of the poison for himself that makes him into an idiot or a brute, was perhaps first led into the habit of drinking by a foolish father or mother who taught him when he was a child to like beer and spirits better than pure water.

- Q. What is natural Thirst ?
- A. That which we feel when there is too little water in our bodies.
- Q. What is the other kind of thirst ?
- A. That which comes from disease and from intemperance.
- Q. How is the natural Thirst best satisfied ?
- A. By Water.
- Q. Can the Thirst from disease and intemperance be cured by drinking ?
- A. No.
- Q. How is the body supplied with water ?
- A. Besides the water we drink, water is contained in our food ; and our skins absorb moisture from the air.

LESSON 13.

A PEEP INTO THE STOMACH.

You will perhaps wonder how people have been able to find out what goes on in the stomach, since we cannot look in and see.

About thirty-seven years ago, a strange accident that happened to a young man in Canada actually enabled an American physician, Dr. Beaumont, to look into a living stomach and see what goes on.

The name of this young man was Alexis St. Martin, and he had a hole made in his stomach by the discharge of a gun, which went off ~~only~~ at about a yard's distance from him.

The young man was very ill and suffered a great deal of pain for about a year after the accident, but at last through the skill and care of Dr. Beaumont he got well again; but the hole in his stomach, which was nearly as large as a half-crown, never closed; Dr. Beaumont was thus able to look inside; and he has written a book in which he tells all that he saw and found out about the digestion of the food.

He saw, amongst other things, that when a mouthful of food was swallowed, the stomach closed upon it directly, and by its churning motion spread it all over the inside so that the gastric-juice mixed with every part; and as soon as it had done this, the stomach opened wide again the passage into the gullet, ready for the next mouthful.

If the next mouthful came down too soon, and before the passage was open, the stomach squeezed up the opening still more tightly to prevent its passing.

If it was forced to open too soon by the mouthfuls coming down too fast one after another, the motion

of the stomach was seen to get irregular and disturbed, and the food did not digest well.

This shows the reason why the gullet is made to swallow slowly. It does so that it may give the stomach time to arrange each mouthful of food in the best way for digesting it before the next mouthful comes down.

Dr. Beaumont *saw* the gastric-juice pour into the stomach when the food came down, and mix with it, and gradually change it into chyme. He saw that some kinds of food turned to chyme much sooner and more easily than others. Thus, bread and meat digested sooner than vegetables and fruit.

He saw that, when it was in the usual healthy state, the inside of the stomach was of a pale pink colour, and as smooth and soft as velvet; but that when anything was eaten that did not agree with it, or when fresh food was taken before the former was digested, an appearance of inflammation spread over the stomach.

Thus, once when Alexis had eaten a quantity of sour apples, the inside of the stomach looked inflamed and rough.

At one time when Alexis had been indulging himself with drinking spirits for several days, Dr. Beaumont found the inside of his stomach covered with ulcers from which ran out a thick kind of blood; the gastric-juice came in very small quantities, not enough to digest the food, and it was mixed with blood

and with corrupt matter like that which runs from a sore.

Dr. Beaumont prevented his drinking any more spirits, and gave him cooling drinks and very simple food for a few days ; and then his stomach began to look healthy again, and the gastric-juice came as usual.

If a few days' drinking did so much mischief, we may imagine what a miserable state of disease the stomach of the habitual drunkard may possibly be in ! He loses the power of digesting food ; he loses appetite, he loses health. No wonder he becomes a torment to himself, and to everybody about him.

The mischief done to the stomach by drinking spirits is not always felt at first. When Dr. Beaumont saw that the stomach of St. Martin was in this miserable condition, St. Martin himself did not feel any pain there. He said only that his stomach felt uneasy and his head was giddy. This shows us that persons who are in the habit of drinking may go on a long time without feeling the mischief they are doing themselves. But they are sure to find it out at last. Some dreadful illness will some day show them the corrupt state of their inside ; or the mind and body will gradually become diseased. If you were to visit a mad-house, you would find that more men had been shut up there because they had made themselves mad with drink than from any other cause.

Q. Why should not we eat fast ?
 A. Because the stomach requires time to arrange each portion
 that is swallowed so that the gastric-juice may act upon
 every part of it.

Q. What did Dr. Beaumont find was very injurious to the
 stomach ?
 A. Ardent spirits.

Q. Is the mischief that hard-drinking does the stomach always
 felt at first ?
 A. No : it mostly produces disease that comes on little by little.

LESSON 14.

WHOLESONE FOOD.

HAPPILY we can tell pretty well what agrees with the stomach without looking inside it.

Thus, if we feel uncomfortable after a meal instead of comfortable, it is most likely we have eaten something wrong, or eaten too fast, or too much.

If we are restless in bed, and waken in the morning with a headache, and have no appetite for our breakfast, it is very often because we have had an unwholesome supper the night before.

A little child will often be fretful and cross because something is not digesting well, and makes it feel

uneasy. It is of no use to scold it or to beat it, for that will not help the digestion at all. It is still worse to coax it into good humour by giving it things to eat—sweetmeats, or cakes, or pastry—for this will only tease the stomach if it is out of order, and make its task of digestion still more difficult.

One good way of keeping a child happy and good humoured, is by never giving it any but wholesome things to eat.

Some people think that if they disorder their stomachs they can set them to rights again by taking medicine ; and so they indulge themselves in eating things that disagree with them, and then take pills and physic to mend the mischief.

But although physic may mend the mischief, it causes other mischief by weakening the stomach and the health altogether. It is curing one evil by another evil.

The best way is never to want medicine ; and people can do more to keep themselves and their children well by buying only wholesome food, than by always having plenty of pills and doctor's stuff ready in the cupboard.

It is a good thing that wholesome food is mostly cheap ; but there are many people so poor that they cannot even buy enough of that for their families, and whose health suffers from having too little food instead of too much.

It is all the more necessary that they spend the little money they have on food that really nourishes ; and especially that they do not spend it on intoxicating drinks, which may ruin both mind and body, and empty the poor man's purse at the same time that they take away his power of filling it again.

- Q. Is disorder of the stomach always felt *in* the stomach ?
- A. No ; it is felt often in the head, and sometimes in the temper.
- Q. Is it best to keep well without medicine ?
- A. Yes.

LESSON 15.

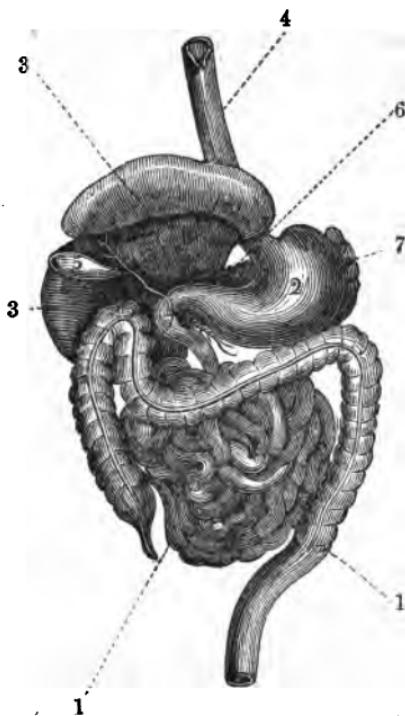
SEPARATING THE NOURISHING PART FROM THE CHYME.

WHEN the food has all been dissolved in the stomach, the next thing to be done is to separate all the coarser parts that are of no use in the body, and to prepare the nourishing part for mixing with the blood.

As soon as the chyme has passed through the *door-keeper* of the stomach, it enters a tube called the

Intestine or Bowel, (1) which in a full grown person is more than 30 feet long.

THE DIGESTIVE ORGANS.



- 1 Intestines.
- 2 Stomach.
- 3 Liver.
- 4 Gullet.
- 5 Gall-bladder.
- 6 Pancreas.
- 7 Spleen.

This immense long tube is folded up as you see in the picture, so as to take up as small a space as possible in the body.

The sides of this tube have the same worm-like motion that the sides of the gullet have, and the chyme is thus gradually pushed along it. As it goes along, three fluids are poured into it; the Bile which is made by the Liver; (3) the Pancreatic Juice which is made in the Pancreas or Sweetbread that lies just beneath the Stomach; and the Intestinal Juice, which is made by the sides or lining-coat of the Intestine.

These three fluids have the curious effect of separating the nourishing part of the chyme in the form of a fluid, thin and fine enough to pass through the smallest vessels; and they also make some other changes in it which render it still more fit and ready to make into blood.

This fine nourishing fluid which is separated from the chyme is called Chyle.

All along the intestine there are the finest veins ready to take up this nourishing fluid as soon as it is prepared; and by the time the chyme has travelled the whole length of the thirty feet tube, all the nourishment in it has been taken up by these busy little carrying vessels, and conveyed by them to large veins which empty it into the Blood near the Heart.

Q. What is the use of the Intestines?

A. To separate the Chyle from the Chyme.

Q. What is the Chyle?

A. The nourishing part of the food?

Q. What is done with the Chyle?

A. It is mixed with the Blood and taken to the Heart.

LESSON 16.

THE SAME BLOOD IS MADE FROM DIFFERENT KINDS
OF FOOD.

WE have now seen the journey the food makes through the body, and what a different thing it becomes at the end of the journey. Whatever kind of food is eaten, this delicate, smooth, milk-white chyle is produced from it which is afterwards made into the red blood that runs through all the veins in the body.

The blood of the little infant is just the same as the blood of the grown-up man, although the one is made from milk, and the other is made from bread and meat and cheese and beer and twenty different things.

The blood of the Greenlander who eats nothing all the year round but whale-blubber or dog-fish or raw seal-flesh, is just the same as the blood of the Hindoo who eats little else but rice. The best dinners that money can buy, and the most costly meats and wines, do not make the rich man's blood a bit better than that of the poor man who may have nothing besides bread and potatos for his daily meal.

It is said in the Bible, "God hath made of one blood all nations of men to dwell on all the face of the earth." But if He had not, with a skill that is more than we can understand, given this power to the digestion of turning different kinds of food into the same

kind of blood, men could not have dwelt on all the face of the earth, and the great human family could never have been fed.

Suppose the thousand million men, women and children who are now living upon the earth, had to be fed on bread alone, where could all the corn be grown to supply them with enough?

We call bread the Staff of Life, but there are whole countries where the people have never tasted it and can do very well without it.

Thousands of poor Irish live on potatos and skimmed milk. Millions of Hindoos live chiefly on rice. The Arab is contented with little else besides the fruit of the date-tree. The people in Kamtschatka feed almost entirely on fish. Those who inhabit the Pampas of South America eat scarcely anything but buffalo beef. Whole tribes of people in Africa have hardly any other food besides a kind of gum. With the inhabitants of some of the East India Islands the word sago means bread, because sago, which is the inside of the stem of a palm-tree, is their chief food. The Esquimaux who live in the frozen regions where it is too cold for corn or any trees and vegetables to grow, are quite satisfied with whale-blubber and any animal fat they can get. Thus men, who were intended to "dwell on all the face of the earth," find food in every country and every clime, if they use their hands and their heads in the right way to obtain it.

Most other animals are made to feed only upon one

or two kinds of food ; and in their natural state, therefore, are found only in those parts of the earth where the food that suits them most abounds.

But men find their food everywhere; on the earth and under the earth; in the sea and in the air; in a countless variety of fruits and leaves and seeds and roots, of beasts and birds and fish, and even of minerals.

And thus the changing seasons, and the endless variety in the forms and colours of trees, plants, and animals, that make this world so beautiful to look at and so pleasant to live in, supply us also with a thousand different kinds of food for our support.

Q. What makes it possible for men to live in all the different countries of the world ?

A. The wonderful power of the digestion to turn into the same kind of blood so many of the different products of the earth.

LESSON 17.

HUNGER IS USEFUL AS A TEACHER.

PERHAPS some may think it would have been better for us if food had been given to us without any trouble on our part, as the grass is given to the cow

or the leaf to the caterpillar. And perhaps it would, if we had been intended to live the life of animals, to eat, sleep, and die.

But we have had powers of mind and body given to us that the animals have not; and the more of these powers we can rightly use, the happier and better we are.

Hunger has in all ages forced men to work as nothing else could. Not finding food ready for them whenever they wanted it, they have had to contrive means of securing for themselves a constant supply. They thus learned to till the ground and sow the seed that would make into bread; they invented tools and machines that would help them to do this work more easily; they found out how to make the soil produce the largest crops, and how to rear in the best way those animals that are best for food. If their own country did not yield them enough, they invented ships to bring food from abroad; and thus all the trouble and pains men have taken to feed their bodies, has made their minds grow, and they have become clever and thoughtful and able to do other things well besides procuring food.

Could the Great Father have educated His children in any better way than by compelling them to make use of the powers and faculties He has given them, and then rewarding their efforts by causing the earth to bring forth food in proportion to their labour? The “sweet singer of Israel,” who nearly three thousand

years ago wrote those grand old Psalms that are repeated every Sunday in our Churches, seems to have counted the necessity for labour as one amongst the many proofs of the goodness of God.

“ He causeth the grass to grow for the cattle, and herb for the service of man ; that he may bring forth food out of the earth.

“ Man goeth forth unto his work and to his labour until the evening.

“ O Lord, how manifold are thy works ! in wisdom hast thou made them all : the earth is full of thy riches.”

Q. How has the difficulty of obtaining food been a blessing to mankind ?

A. It has forced them to work and to use their powers both of body and mind.

Q. Can we be happy if we do not use these powers ?

A. No.

PART SECOND.

LESSON 18.

WHY DO WE BREATHE ?

If we were to stop breathing for a few minutes we should die.

What then do we do every time that we breathe that is so important to our life ?

We do two things when we breathe. We breathe something in, and we breathe something out.

We breathe in the air from without; and we breathe out from the mouth and nostrils, in the form of bad air and moisture, those parts of the blood that are no longer of any use in the body, and have become impure.

We have seen how the Blood that nourishes us is made from the food that we eat. But the blood, after it has received the Chyle from the food and been poured into the heart, requires something else to be brought to it to make it into pure and proper blood.

That *something else* forms part of the air around us, and is called Oxygen ; and all the blood in our body

has to be exposed to the air that it may be acted on by the oxygen in it.

No one has yet been able to find out exactly why it is that we cannot live without oxygen; but it is supposed that the oxygen clears away the impurities from the blood by changing them into the form of a gas, or bad air, (called carbonic acid,) that can be breathed out. But whatever it is that oxygen does to the blood, we know that if the blood is sent back to the heart without having been exposed to the oxygen in the air, it kills directly, like a deadly poison. Thus when a person is drowned, he dies because the water prevents the air going down the wind-pipe, and no oxygen therefore can get to the blood; and the blood having to flow through the body without, stops the action of the heart and brain, and causes death in a few minutes. When a man is hung, or suffocated in any other way, death takes place from the same cause.

We cannot see this oxygen any more than we can see the air of which it forms a part; and yet without seeing it, the chemists are able to separate it from the air and fill bottles with it, or any vessels that are air-tight, and to find out in what way it is different from the common air around us.

You know that without seeing the air, we can often feel what a real, strong thing it is; when it drives in our faces during a storm; when it shakes the mighty trees of the forest, and uproots the oak; when it lashes up to fury the waves of the ocean, and snaps in two the huge masts of a ship.

You have all seen india-rubber balls, and balls made with bladders which are stuffed with nothing but air blown in until it is quite hard. Air is also used for stuffing cushions by being blown into air-tight cases.

In the same way that we find the air to be a real thing without seeing it, so without seeing the oxygen itself, we can see its effect on other things. Thus, if a bottle is filled with oxygen, it weighs heavier than if it is filled with common air. If a lighted candle is put into a bottle containing oxygen, it burns much more brightly than in the common air.

If the candle is blown out and then put into the oxygen while the wick is red, it instantly lights up into flame again ; and even a red-hot wire will flame and burn up in oxygen like a piece of stick.

But if you put a lighted candle into air that has no oxygen in it, it goes out instantly. It is the oxygen in the air that produces fire ; for fire is caused by the rapid union of fuel with oxygen. We are able to light a fire and keep it burning because of the oxygen in the air ; and when we blow the fire with the bellows, it burns up better because we supply the oxygen a little faster.

Oxygen, then, is necessary both to Life and Combustion.

- Q. What do we do when we breathe ?
- A. We take in fresh air, and we breathe out bad air and moisture.
- Q. What is there in the air that is necessary to life ?
- A. Oxygen.

LESSON 19.

HOW IS THE BLOOD EXPOSED TO THE AIR?

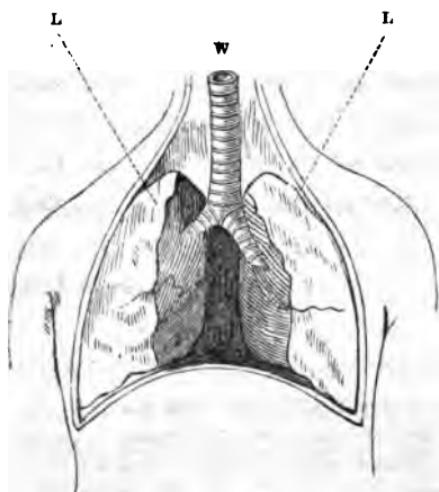
SINCE the blood is all shut up in our body, how can it all be exposed to the air?

It is by means of the Heart and Lungs that this is done. The Lungs are two masses of a kind of flesh that is full of little cells like a sponge. You have seen what are called *lights* in butchers' shops. Those are the lungs of animals.

The Lungs, by means of all these little holes or cells, can become filled with air as the sponge can be filled with water.

The air goes down into the lungs through the Wind-pipe every time we breathe.

WIND-PIPE AND LUNGS.



In this picture you see how the wind-pipe, (w,) Digitized by Google

divides into two branches which go one into each lung, (L L).

These two hollow branches, when inside the lung, divide into a great many smaller tubes which take the air to the air-cells.

These small air-tubes or branches of the wind-pipe are called Bronchial Tubes ; and when we have a very bad cold and feel our chest sore, it is because these tubes have become inflamed.

It is supposed that there are as many as six hundred million air-cells in our lungs ; and every time we breathe, we fill them with air.

The Heart sends the blood into the Lungs to meet the air in these cells.

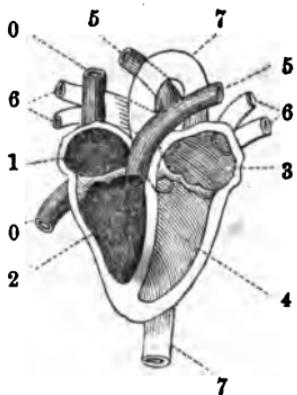
The Heart is a little larger than a person's fist when doubled up. It has four hollow places or chambers in it. To keep it moist it is inclosed in a sort of smooth bag which is always wet inside.

Look at the picture at page 12 and you will see that the heart is placed between the right and left lung, and you will also see the edge of the bag that holds it, (2). The bag has been cut open to show the heart inside.

You remember that just after the Chyle from the food is mixed with the blood, the blood is poured into the heart through large veins. In this little picture of a heart cut open, the ends can be seen of these two large veins, (0 0) which both empty into

the first of the four cavities or chambers of the heart, (1).

HEART CUT OPEN.

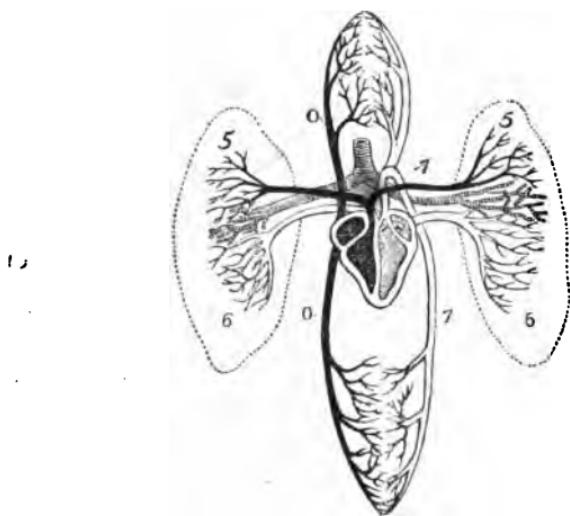


- 0 0 Veins that bring the dark blood to the Heart.
- 1 First chamber of the Heart.
- 2 Second chamber.
- 3 Third chamber.
- 4 Fourth chamber.
- 5 5 Artery taking the dark blood to the Lungs.
- 6 6 Veins bringing back the red blood to the Heart.
- 7 7 Great Artery that distributes the red blood all over the body.

The blood that these veins take to the heart is of a dark purple colour. It is made afterwards into good crimson blood by the action of the air upon it in the lungs.

The way in which the heart sends the blood to the lungs, and then through the body, may be understood by looking attentively both at this figure and at the next one of the Circulation of the Blood, which

although it is not an exact representation of the heart and blood-vessels and air-vessels, will serve to give some idea of the course the blood takes through heart, lungs, arteries, and veins.



CIRCULATION OF THE BLOOD.

As soon as this dark-looking blood from the veins is poured into the first little chamber of the heart, (1,) it passes down through a valve, or opening into the chamber below, (2).

A Valve is a little piece of skin, loose at one edge, and fastened at the other; something like a door on its hinges. These little doors only open one way, and always shut again directly, so that when anything has

passed through them, it cannot get back again. So when the blood has passed through the valve into the second chamber, the little door shuts behind it, and it cannot flow back again ; and this second chamber of the heart then squeezes itself together, or contracts, by means of the strong fibres of flesh that surround it, and so forces the blood upwards through the artery, (5 5,) which branches off right and left into the two lungs.

Directly the blood meets with the air in the lungs it changes from a blackish or dark purple colour to a bright red. It takes in the oxygen from the air, which is supposed then to unite with the impurities or dark matter in the blood, and to turn them into a gas, which we immediately breathe out.

The blood thus purified and made red, is then sent back to the heart through the veins that look white in both the pictures, (6 6). But the red blood does not return to the same chamber in the heart that the dark blood is sent from. It pours into the third little chamber ; then it passes down into the fourth, which immediately contracts or squeezes together strongly, and sends the blood through the great artery, (7,) through which it passes into the other arteries in all parts of the body.

Every time the heart beats,—about 70 times a minute, more than 4,000 times an hour,—is this task gone through of making the blood ready for use in the body! About 18 times in a minute, when we

breathe in the usual quiet way, the lungs stretch themselves out to receive the air ; the heart sends the dark blood to the lungs ; the oxygen leaves the air and purifies the blood and turns it red ; the bad air is set free and breathed out ; and the warm red blood returns to the heart ready to be sent through the body !

If the heart were to grow tired for an instant and neglect to send the blood to the lungs ; if the lungs were to refuse to stretch out and receive the air,—we should die as certainly as if we had been drowned.

How helpless it makes us feel in the hands of the Great Power that sustains our life, to know that our life depends every moment on the motions of parts inside us that we have no control over !

But if it makes us feel helpless, it makes us also feel how entirely we may trust in the unceasing care that makes our hearts beat and our lungs breathe without any trouble or thought on our own part.

Food we can wait a little for ; He has therefore left it to ourselves to procure that. But Air we must have every moment ; He has therefore surrounded us everywhere with this pure, soft, refreshing element, and made our lungs open of themselves to drink it in.

- Q. What is the use of the Lungs ?
- A. To bring oxygen to the blood by becoming filled with air.
- Q. How does the air get into the Lungs ?
- A. Through the Wind-pipe and Bronchial Tubes.

Q. How does the Blood get to the Lungs ?
 A. The Heart sends it there.

Q. How does the heart send it ?
 A. By contracting strongly.

Q. What colour is the blood before it has been to the lungs ?
 A. A dark purple.

Q. What colour is it when the oxygen has acted upon it ?
 A. A bright crimson.

LESSON 20.

HOW THE BLOOD IS SENT THROUGH EVERY PART OF THE BODY.

THE Heart, having done the first part of its task,—that of sending the dark blood into the Lungs to be purified,—has next to send the red blood all through the body.

There are two sets of hollow tubes which take the blood all round the body. They are called Arteries and Veins. See the picture of the Artery at page 11.

The Arteries convey the pure red blood *from* the heart; the Veins bring back the dark impure blood *to* the heart.

Look at the heart on page 57, and you will see the beginning of the great artery, (7,) that takes the blood out, and the ends of the great veins (0 0), that bring it back again.

If you put your hand to your left side you feel the

heart beat. If you put your ear against another person's side, you may hear the sound it makes in beating.

That beating is caused by the two lower chambers of the heart, or *ventricles* as they are called, contracting suddenly and squeezing the blood out.

The ventricle 2 squeezes out the dark blood and sends it to the lungs, (as we saw in the last lesson,) while the ventricle 4 on the other side squeezes out the red blood that has been sent back from the lungs, into the great artery which opens into it.

This great artery is called the Aorta. It branches off into smaller arteries, just as the trunk of a tree branches off into boughs and twigs, as you see in the picture of an artery at page 11; and there are such an immense number of these branch arteries, and most of them are so fine and small,—much smaller than the finest hair—that they can go into every part of the body.

Some of you have perhaps seen the steam-engine at the Waterworks, which pumps the water and drives it with immense force along the pipes under-ground that take the water to the different houses in the town. The water, when it is first sent out by the engine, rushes with such violence that it would burst the pipes if they were not made very strong indeed. And therefore the pipes next to the engine are made of great strength and thickness.

Now the heart is something like that engine. It

drives the blood with such force into the Aorta, that if the artery were pricked, the blood would spurt out like a little fountain ; and the artery would burst with the rush of the blood into it if it were not very strong.

We find, therefore, that the Aorta is stronger than all the other arteries and veins. It is composed of three layers of thick, tough skin, which, although as firm and strong as the hardest gristle, will yet bend as easily as leather.

It is always very dangerous when a large artery is cut or pricked, because the blood runs so fast through it that we might bleed to death before it could be stopped. Great care has therefore been taken to protect the arteries from injury. The larger ones never lie just under the skin, as some of the veins do, but are enclosed in the flesh, or are placed inside the bones ; and some have grooves made for them, where they lie almost quite safe from cuts and wounds. For instance, an artery lies along the bone on the inside of each of our fingers, and the bone is so hollowed out for it to lie safe, that you might cut the finger across to the bone without touching the artery. It is but seldom therefore that a large artery is cut by accident. When you cut or prick yourself anywhere so that the blood comes, it is almost always a small vessel that is wounded, and as the blood runs slower through these, it does not signify much.

Look at the under side of your wrist, and you will see the veins just under the surface, with the dark-

purple blood in them; and if you press your fingers a little below the wrist, on the thumb side, you will feel an artery beating or throbbing.

That beating is caused by the blood rushing along with a sort of jerking motion, and it is called the Pulse. Wherever a large artery is felt, there is this same throbbing motion, or pulse.

The arteries beat just as often as the heart beats ; because the heart beats each time that it contracts and sends out blood into the artery, and the artery beats as each fresh quantity of blood flows into it with a sort of jerk. The heart and arteries of most healthy grown-up persons beat about 70 times in a minute. In some kinds of illness they beat faster,—that is, the blood flows faster; in other kinds of illness it flows slower ; and when the doctor feels the pulse at our wrist when we are ill, he can often tell how much is the matter with us, by the way in which the blood rushes along, and the speed at which it flows.

This quick motion of the pulse shows us the quickness with which one wave of blood follows another. And yet think of the two important things the blood has to do while it is running at that rapid rate. It takes up and carries away with it the old and waste matter from every part ; and at the same time it gives to every part fresh nourishment. It is like putting coal on the fire, and carrying away the ashes at the same moment !

This wonderful living fluid carries in itself the

materials that are wanted to make into all the different substances in the body. To the flesh the blood gives what will make into flesh ; to the brain it gives what will make into brain ; to the bone what will make into bone ; to the skin what will make into skin ; and it not only renews and keeps alive every solid part of the body, but it supplies the fluids,—such as the gastric-juice, the bile, the saliva, the tears. So that when the blood has finished its journey through the arteries, it has parted with its nourishment, and become loaded with waste matter ; it has lost its red colour and become almost black ; it is no longer able to feed the body and support life ; and if it were to stay in the body just as it is, it would act like poison, and kill us.

What then is to be done with it ?

Now is seen the use of the other set of tubes, the Veins. The Veins commence by little hair-like vessels that collect the blood ; which then runs along the smaller veins into the larger veins, until it reaches the large vein near the heart. Here the fresh Chyle or nourishment from the food pours into the blood, and then it is carried back into the heart. Then, as you know, the heart sends it to the lungs, where it is made into good red blood again by the oxygen from the fresh air, and by the waste matter which it has collected in its passage through the body being breathed away from it.

And so the blood is ready to begin its course through the heart and arteries again.*

This flowing of the blood, first into the Lungs, and then all over the body, is called the Circulation of the Blood. The word circulation is made from two Latin words, *Circum*, around, and *latum*, carried. It is said that this journey which the blood makes through heart and lungs and body is completed in a little less than three minutes; the heart having to beat about four thousand times an hour to enable it to travel at this rapid rate.

And yet how quietly this rapid stream of life flows on within us; never stopping an instant from birth till death! So quietly it flows, that we see and feel nothing of it but the gentle tap of the heart, and throb of the pulse; and it was many thousand years before even learned doctors guessed what was the real use of the heart, and how the blood circulated.

Nearly three hundred years ago, a clever and learned man, Michael Servetus, found out that the

* It is probable that the same particles of blood do not immediately return to the lungs. They may remain some time in the tissues, taking the place of other particles which rejoin the circulation. As four-fifths of flesh is fluid, only a small part of the total fluid of the body is contained in the blood vessels. It is like the rain,—that which falls to-day sinks into the soil, and displaces some which fell months ago; the springs and streams are fed immediately, not by, although in consequence of, the falls of rain. So blood, entering an organ or muscle full of blood, need not pass at once through it, but may displace an equal quantity, and so appear to pass through.

heart sent the blood to the lungs to be exposed to the air.

But such was the barbarous ignorance of men in power in those days, that the book in which Servetus had written about his discovery, was publicly burnt, and he himself was burnt to death at the stake at the desire of John Calvin, a great religious teacher at Geneva, because his religious opinions were not the same as his own.

Some years after Servetus had found out the circulation of the blood in the lungs, an Englishman, Dr. Harvey, found out the other part of the circulation, namely, that the heart sends out the blood into the arteries, and the veins carry it back again to the heart.

It seems strange that it should be so difficult to find out what is going on inside these living machines, our bodies ; so that most of us know no more how they do the work that they have to do, than a little child looking only at the outside of a flour-mill knows how the corn is ground.

Men of great science and learning have by little and little found out the *use* of the heart, the lungs, and other parts of this wonderful machinery inside us ; but the great secret is still hidden from us—WHAT sets the machinery in motion ?

Q. What does the heart do with the red blood ?

A. Sends it into the arteries.

Q. What is the beating of the heart ?

A. The motion of the heart as it sends out the blood.

Q. What makes the Pulse ?
 A. The motion of the blood in the artery.

Q. What does the blood do as it runs along the arteries ?
 A. Clears away the waste matter, and leaves in every part fresh nourishment.

Q. What do the Veins do ?
 A. Carry back the dark-coloured blood to the right side of the heart.

Q. What becomes of the dark blood ?
 A. It is made into good red blood again by receiving fresh Chyle from the food, and by meeting the air in the lungs.

Q. What is this course of the blood all over the body called ?
 A. The Circulation of the Blood.

Q. What is the meaning of circulation ?
 A. Carried round.

LESSON 21.

HOW TO KEEP THE BLOOD PURE AND HEALTHY.

Now that we have seen how the Blood is made, and that Oxygen from the air as well as Chyle from the food is necessary to make it into the living fluid that supports our life, it will be easier to understand the harm it does us to breathe impure air.

We breathe about 18 times in a minute, when we breathe in the usual quiet way ; and every time we breathe, we take into our lungs about as much air as would fill a pint measure, and we breathe out nearly a pint of bad air. The oxygen in that quantity of fresh

air is enough to purify the blood at that moment in the lungs. Now if the air that we breathe has *no* oxygen in it, life and motion stop, and we die. The left ventricle of the heart which pumps the red blood into the arteries, refuses to pump, and stops working, if the blood comes into it dark instead of red.

If the air that we breathe has *too little* oxygen in it, the blood goes back to the heart only half alive; the heart pumps it out but feebly, and as it runs through the body it cannot give the life and strength that it ought.

Now it is very plain that if many persons are together in a close room, and each person breathes in about 18 pints a minute, and breathes out nearly as much bad air, the good air in the room must soon be used up. And long before the good air is used up, it becomes so mixed with bad air, and especially with the animal vapour from the skin and breath in a state very ready to become putrid, that it is unfit to breathe; and those who continue to breathe it may be made very ill. Fatal illness has been thus caused, and very often such want of fresh air has caused diseases to become fatal, which would not have been even dangerous, if fresh air had not thus been kept away from the lungs.

It is therefore no wonder that people often complain of feeling faint and ill when they have sat for some hours in crowded rooms, such as theatres, concert or lecture-rooms, especially at night when there are gas-

lights or candles burning in the room. For you remember that fire wants oxygen to support it as well as life, and the lamps therefore help the lungs to rob the air of its oxygen.

Some years ago, before it was so well understood why fresh air is necessary to us, people used to suffer more than they do now from the want of it in the houses they lived in, the factories they worked in, and the schools where the children were taught. Factory-workers and needle-women, for instance, almost always looked pale and sickly, because the rooms in which they worked all day long were not kept well aired, and so the numbers of people in them breathed over and over again the same bad air; and poor little children were often packed together in a school-room not half large enough for them all, and were expected to do their lessons well while breathing an air that made them feel more dull and drowsy every minute.

How glad those children must have been to run out into the fresh air when school was over! By the time they reached their homes, they were, most likely, quite brisk and lively again from the walk in the open air. But they were much to be pitied if when they were at home, they had to live and sleep in rooms that were seldom opened to the fresh air, and were full of bad smells from want of cleanliness. Such children could hardly grow up healthy.

They might grow up to be used to dirt and bad air, and to think that they were none the worse for it; but

this would not prevent their really being the worse for it. For it is certain that we can never get used to bad air unless our lungs have become too feeble to do their proper work. Have you never noticed how much more we feel the want of fresh air when we *first* go into a hot, crowded room, than when we have been in it some time? Those who cry out to have the windows opened are mostly those who have just come in from the fresh air; but the persons who have been sitting in the room a long time do not mind so much about the closeness of the room.

Now the reason of this is, not only because those who have just come out of the fresh air smell and feel the foulness more than those who have got used to it, but because their lungs are in better order; they are breathing freely and strongly, and find it as hard to bear the want of the usual supply of oxygen, as a hungry, healthy child finds it hard to bear the being balked of half his dinner. But after they have been in the room some time, *their* lungs also become weak with the bad air, and then they no more feel uneasiness from the want of enough oxygen than the sickly child who has no appetite feels the want of food. But the injury to the lungs is done just the same, although they do not feel it at the time.

The mischief that is done from breathing impure air often shows itself very slowly. Poor people who have to earn their living in close, crowded workrooms, and whose own houses are so small

that they can hardly keep themselves warm without shutting out every breath of fresh air, often find themselves getting out of health, they hardly know why. They cannot digest their food well,—they often have head-aches,—they often take cold ; and if they have any sort of illness, they have not strength to recover from it as a healthy person would. One reason of their weakness most likely is that their blood has not received enough oxygen to keep it pure and capable of nourishing the body ; thus, the thin and starved appearance of many workpeople in crowded manufactories is more often owing to want of fresh air than want of food.

That fatal disease of the lungs, called Consumption, which carries off more young persons than any other sort of illness, is often brought on by constantly breathing bad air. We often see poor young women, who were once healthy, rosy-faced children, growing very pale and very thin, with a bad teasing cough, and with their lungs so stopped up by disease that they can sometimes hardly breathe. If you ask them, What made you so ill? they very likely will answer, " It was a bad cold I caught." They do not perhaps know that the mischief began in their lungs before the cold was caught, and that the cold would have got well again, and would not have brought on Consumption, if the lungs had not been made weak beforehand.

Of course bad air is not the only cause of disease ; but it is found out to be one of the causes, because

much fewer people fall ill and die young when they live in houses where the air is pure and wholesome.

About 80 years ago, there was a Hospital in Dublin for mothers and their new-born infants, where there was not much care taken to keep the air pure. The poor little babies died off very fast in that Hospital. Seven thousand six hundred and fifty infants were born there in four years' time, and nearly three thousand of them died. But the next four years better means were taken to keep the air wholesome ; and then only 279 died out of the same number. So the lives of more than two thousand children were saved by letting their little lungs have as much fresh air as they wanted.

Of late years, clever men, who have given themselves a great deal of trouble to find out how the poor can be saved from so much suffering and illness, have invented ways of building houses so that enough fresh air is let into them without their being cold and damp ; and Factories, School-rooms, and Hospitals, built in this way are not the close, wretched places they used to be. Houses for the poor are beginning to be built in the same way ; and we may hope that in some years' time every working-man may find a house to live in where the air can be kept pure, at the same time that it is warm and comfortable.

Here we see how useful knowledge may be made, and how much the men who think and contrive can help those who have to labour with their hands more

than their heads. There was once a time in England when the people were content to live in huts made of mud or clay, with no fire-places, chimnies, or windows, and with only a hole in the roof to let the smoke out, and a hole at the side to serve as entrance, and to let the air and light in.

Now, in these days, thanks to those who have used their brains well for the good of others, the cottage of the poorest man has more comforts in it than the palace of the King some hundred years ago.

But in whatever way houses are built, and whether they belong to the rich or the poor, the comfort and health inside them depend a great deal upon the sort of people who live in them. We may go into many a poor man's house, and find it more sweet and clean and pleasant to live in than some very grand houses, where there are plenty of servants to do the work, and plenty of money to spend. And we may go also into many houses, big and little, where the bad air and sickening smells almost drive us out again, because the people who live in them are dirty in their habits and ignorant of the value of pure air.

If you ever grow up to have homes and families of your own, and yet have very little money to spend upon food and clothing and other comforts, you can still make the best of these two cheap luxuries,—fresh air and water. You can change the air constantly in your bed-rooms and other rooms ; even in winter time, you can open the windows at least once a-day, when

there is no one there to take cold from it; and you can keep your houses clean and your skins and clothes clean, and clear away quickly everything that is dirty, and that can taint the air; so that at least you and your children may have wholesome air to breathe, if they cannot have many other things that they need.

- Q. What harm does it do us to breathe bad air ?
- A. It makes us feeble and liable to illness.
- Q. How is it that people get used to breathing bad air ?
- A. Because they lose the nice sense of purity which those have who breathe pure air.
- Q. How is it that some people do not seem to feel the want of fresh air ?
- A. Because their bodily powers are so depressed or weakened that they do with less air, as a sick person does with less food.
- Q. Are not they injured, then, by the want of pure air ?
- A. Yes: but they do not *at the time* feel the injury so much as if they were strong and vigorous.

LESSON 22.

HOW THE AIR OUT OF DOORS IS KEPT PURE.

SINCE the air in our houses so soon becomes impure from our breathing in it, you may perhaps wonder how it is that the great Atmosphere itself,—that is, all the air about the world,—does not become impure from

the multitude of living creatures that are constantly breathing up its oxygen, and breathing out into it the bad air from their lungs.

For it is not only men, women, and children that must have oxygen to support their life, but also every other animal. The little worms that live in their holes under-ground, want the oxygen from the air just as much as the cows and sheep, and all the larger animals that live on the surface of the earth, and would die if the air did not get to them through the pores in the ground. Even the fishes could not live under water if the water did not contain air enough for them to breathe.

Think then of the numbers that have constantly to be supplied with oxygen,—the thousand millions of men, women, and children; and the myriads of beasts, birds, fishes, and insects that find their home on this great globe! And yet the supply of oxygen never falls short. Almighty Providence has made the air so vast, that there is never any fear that the quantity of oxygen should not be enough for all.

The air is supposed to reach to about 40 miles upwards from the earth, and it quite surrounds the earth, which is a great ball 24,000 miles round. So immense therefore is the supply of air, that it has been reckoned that all the men and animals in the world might go on breathing up the oxygen for ten thousand years, without any difference being made to the air that could be felt.

But there is another reason why the supply of oxygen never fails. Plants and trees and vegetables live and grow as well as animals; and like the animals their life is supported by taking in food, and by breathing in one kind of air and breathing out another kind. They suck up their food through the roots; and they breathe through the little pores or holes in the fine skin or peel that covers the leaves.

Now the kind of air that they want to make them live and grow is just that kind that we breathe out of our lungs, and want to get rid of; so what is bad air to the animals is good air to the plants.

The breath of animals that has mixed with the air is therefore taken up by the plants; and the air that the plants give out in return is this very oxygen that the animals require.

Animals and plants are thus made to help each other to live; and vegetables and fruits, besides serving as food, help to provide for us the oxygen that we breathe.

The air around us is also kept pure by means of the Wind, that we sometimes think so troublesome; it is constantly changing the air and keeping it healthy; and if in one place the air has become impure, a stream of fresh air from over the sea, or other places where the air has not been so much breathed into, rushes in and carries off the bad air.

If you could *see* the air, you would find that it was constantly waving about like the ocean. When these

waves or currents of air are strong enough to be felt, we call them Wind ; and it is by this constant motion that the air is kept from becoming stagnant, and bad for us to breathe.

Besides being necessary to our life, how beautiful to look at is this great Air-Ocean ! What can be more lovely on a fine day than the blue heavens stretched like a tent over the earth ; or what more grand on a stormy day than the huge, dark clouds, with their gold and silver edges, sweeping across the sky !

And yet this element of Air, so vast in extent, and so strong and terrible when stirred up in tempest, is usually so soft and quiet and yielding; that it hardly hinders the flight of the smallest fly ; and all the living creatures whose life it is sustaining every moment, are scarcely conscious of its existence. Does not this great atmosphere,—invisible, yet life-supporting,—make us think of the Invisible One, without whose constant presence nothing in the air or on the earth would have power to support our life for a single instant?

Q. How do trees and plants help to keep the air fit for animals to breathe ?

A. By giving out Oxygen, and by using up the impure air.

Q. How does the Wind help to purify the Air ?

A. By carrying off the impure air and bringing in streams of fresh.

Q. What makes it certain that the supply of good air can never fail?

A. The immense extent of the atmosphere, and because all plants are constantly absorbing from it the air which animals breathe out, and are giving off into it the oxygen that animals require.

LESSON 23.

HOW DOES EXERCISE HELP THE BLOOD TO CIRCULATE?

If you could look inside your bodies, and see all that is going on, you would hardly guess that moving about could do us any good.

When you saw the heart pumping, the lungs bl~~ea~~ing, the blood rushing along, the sinews pulling, the valves opening and shutting, the flesh or muscles swelling and shrinking,—you would most likely feel half frightened, and think to yourself, “I must not move; I must keep quite still, or I shall break something, or stop something;” and you would no more think it would do you good to run and jump about, than you would think it would do a clock good to toss it about or trundle it along the ground. How miserable it would be for us if this were so; and if we had to keep sitting or standing quite still in one place all our lives!

But we were made to work and be active, and not to stand still; and therefore the machinery of our bodies, which is more fine and delicate than any machinery that men can make, is yet so suited to our wants that it is all the better for being moved about.

Look at boys playing at leap-frog, or running races, or going head over heels; look at girls with their swings or their skipping ropes,—how they all jerk and twist and tumble about their bodies in all sorts of ways; and yet all the time the little heart goes on with its regular tap, tap, tap, against the ribs, and lungs and every other part keep steadily to their work, quite undisturbed by all the odd jumps and jolts; and if they do go on a little faster for the exercise, it does them good, and not harm.

It is because exercise makes the heart and lungs and every other part work faster that it does us so much good; and it is always best if the exercise is in the open air.

People who stop in doors all day, and sit still a great deal, suffer from illness and ailments that never trouble those who have plenty of walking and stirring about in the fresh air. There is many a rich lady who hardly knows what good health is, because she perhaps only takes exercise by going out in her carriage, or by walking from one room to another. And there is many a poor woman whose health is just as bad, because she is obliged to get her living by sitting still at her work in one room all day long.

Both these women suffer from the same cause. Their blood runs too slowly, and all their powers of life are therefore sluggish and feeble. Their digestion is slow and they have little or no appetite; they cannot sleep soundly at night, and therefore are only half awake in the day-time. They are always chilly, and have cold feet or rheumatism in their joints. The fine lady will perhaps send for her doctor, and he will give her medicine to mend her health; and she will try and tempt her appetite with all sorts of delicacies; and the poor woman who cannot afford either doctor or delicacies, will perhaps take to drinking gin to keep her poor chilly body warm. Both women are wrong. The gin will certainly make matters worse in the end, and most likely the medicine will also. What they both want is regular exercise in the open air.

The country-woman who has to walk many miles to market with her basket of eggs and butter and garden-stuff, is seldom troubled with want of appetite or bad digestion, or with chilliness and rheumatism either, unless she is an old woman. She may be very tired and over-worked sometimes; but she has altogether a better chance of health than the rich lady who will not take exercise because she is not obliged to do it, or the poor woman who cannot take it if she would.

But how does exercise make the blood run faster? One reason is said to be this. The motion of our bodies

and limbs makes the muscle or flesh press upon the blood-vessels that lie inside the flesh ; and this pressure makes the blood inside the vessels run along faster ; just as in a leathern water-pipe the water could be made to run faster by squeezing the pipe. The blood cannot run back to the heart ; so when we walk and move about, the blood is pressed on faster in the right direction through the arteries and veins.

The blood running faster, everything else goes on faster. The heart has to beat faster ; the lungs have to breathe faster, that the air may be there in time to meet the blood ; the red blood is sent round again into the arteries sooner ; and it clears away faster the waste matter and feeds every part quicker as it runs along. This quicker motion gives more life and vigour to every part of the body. The stomach digests better, the intestines separate the chyle from the chyme better ; the skin perspires better ; and the appetite is better, because the meals are so well and quickly disposed of. Thus, labouring-men who work hard in the open air all day long, want much more food and drink than those who live a quiet life ; because they breathe and perspire more and faster, and they are therefore hungry again sooner and want more food to make up the loss.

Exercise in the open air helps the circulation much better than that which is taken in-doors ; because more oxygen from the fresh air being brought to the blood, the blood has more life in it, and flows faster.

It is use and exercise that make every part of the body grow strong ; because wherever there is action and motion, there an increased supply of blood is sent immediately ; and this in time makes the part thus used grow strong and large. Look at the blacksmith's arms,—how large and strong they are from constantly using them. Look at the tailor's legs,—how thin and weak they often are, from being doubled up all day and not much used ; and look again at soldiers and sailors and those who use all their limbs equally, how straight and well-grown they are.

Of course, then, that is the best kind of exercise which puts in motion every part of the body.

We cannot many of us choose for ourselves the trade or calling in life that we like best, or that best suits our health. We must do our duty and work as well as we can wherever we are placed, and whatever we have to do. There are many whose business obliges them to stir about so much, that there is no need to tell them to take exercise, for they have perhaps more of it than is good for them. But there are others whose work it is to sit or stand at some one employment all day long. If when you grow up, your work should be of this kind, you must make the best of it by getting, if you can, at least a little walking in the open air every day ; and if you are able to choose your own time for it, take your walk in the day-time, and not at night when the air is damp ; and never take violent exercise after a hearty meal.

Q. What good does moving about do us ?
 A. It makes the blood run faster.

Q. What is the best kind of exercise ?
 A. That which is taken in the open air; and that which exercises the whole of the body.

Q. What harm does it do us to take no exercise ?
 A. The blood then circulates slowly and feebly, and this makes every other part act too feebly to keep up the strength.

Q. When is it better not to take violent exercise ?
 A. Just after a hearty meal.

LESSON 24.

WARMTH OF THE BODY.

WHEN you get into a cold bed on a winter's night, have you never thought it rather curious that your body should so soon be able to warm the bed for itself; and that however cold you felt on first lying down, the heat inside your body, like a fire constantly burning, should keep up the warmth of the bed, which makes you lie there so comfortably till the morning ? It would take quite a good fire to heat through the bed and bed-clothes so well as your body warms them.

Where does this heat inside us come from ? for it is just the same in winter as in summer; whether we feel cold or whether we feel warm.

If we were to die in the night, our bodies would no longer warm the bed, but would become as cold as the air in the room. This shews that the warmth inside us is caused by that wonderful thing which is called Life.

It is not exactly known how it is that wherever there is life, there is also warmth ; but it is supposed that this heat is caused by the oxygen acting upon the blood, as the heat of the fire is caused by oxygen acting upon the fuel ; and that therefore the warmth of the body is kept up, both by the air that we breathe, and by the food which forms the substance of the blood. This heat being produced in the blood, it is the blood that carries it to every part. When we die, this action of the oxygen on the blood ceases, the blood stops flowing, and every part becomes cold.

When we feel cold, it is only our skin, or hands and feet that are cold ; we do not feel cold inside, for the warmth there is always very nearly the same. If we sit close to the fire, and warm ourselves, it is the outside only of our body that is warmer ; the heat of the fire does not make the blood any warmer. If we jump into cold water, it is only the skin that feels the cold, the blood is not in the least cooled by it. Men who have to work in the midst of great, hot furnaces, such as forge-men, blacksmiths, engine-men, or workers in iron-foundries and glass-works, are no hotter inside their bodies than the divers or fishermen who almost live in the cold water.

If this were not so, and if our blood could be made to change from hot to cold as our skins do, we could not keep alive by any amount of clothing, fires, or shelter ; we should perish with the summer heat, and the winter cold ; a large fire in the room or a cold bath might be the death of us ; for it is found that a certain degree of heat or of cold in the blood, causes death.

The blood may become hotter or colder from causes *within* us ; for instance, fever makes it hotter ; want of food makes it colder ; but it has such a power of resisting the heat and cold that is outside the body, that persons have been known to get for a few minutes into ovens that were hot enough to bake bread, and although they felt the heat on their skins, their blood kept as cool as before : and we know that travellers to those frozen regions, where the breath turns to ice immediately, never find that their blood is likely to freeze. Intense heat or cold may destroy life ; but it is from other causes, and not because they alter the temperature of the blood.

It is because the blood thus so wonderfully and strangely always keeps at about the same degree of warmth, whatever the heat or cold outside may be, that people are able to live in all climates and to bear all seasons. The Esquimaux who dwells amidst the ice and snow of the polar regions, has as much warmth in his blood as we have on a summer's day ; while the negro who lives under the scorching sun of the tropics, has no more heat in his blood than

we have on a winter's day. Indeed it is said that when the weather is cold, and the climate is cold, the heat in the blood is a *little* greater, and this *little more* heat inside enables people to bear the outside cold better.

Perhaps men, with all their learning, will never be able to find out exactly how it is that the blood in a living body is so different to all other fluids in the world that it has the power of always maintaining nearly the same degree of heat; but since our life depends upon its being so, is not this another of the many proofs that our life is cared for by the Goodness and Wisdom that orders all things?

- Q. Where does the heat inside the body come from ?
- A. It is produced by the action of Oxygen upon the Blood.
- Q. Is the blood made hotter or colder by the heat and cold outside us ?
- A. No : not unless the heat and cold are great enough to destroy life.
- Q. Do not, then, the heat and cold outside make our bodies feel hotter or colder ?
- A. Yes : in the skin and in our hands and feet, but not *inside* our bodies.
- Q. When is our blood the warmest ?
- A. In cold weather.

LESSON 25.

WHEN IS COLD DANGEROUS ?

No part of our body can feel warm unless the blood is flowing freely in it ; and the reason we feel chilly is because the cold makes the little blood-vessels that lie just under the skin shrink up, so that the blood has not a free passage through them.

Now warmth makes these blood-vessels stretch out or expand, so as to make plenty of room for the blood to flow along them. Your skin looks pale and shrivelled when it is cold because the little veins have been shrunk up, and so the blood has been prevented coming to the surface. But if you come near the fire, the warmth opens wide again the little veins, and the blood coming back again into them makes the skin look full and red again, and the warmth therefore continues for some time after you have left the fire.

Everything that makes the blood run freely into the skin makes us feel warm. You know, when you blush, how hot and red it makes you,—that is because the blood rushes suddenly into the skin.

For the same reason, a good walk or run, or exercise of any kind, makes us warm even in cold weather, because the motion makes the blood run more freely into the skin as well as to every other part. If the weather is ever so cold, so long as the blood circulates freely through the skin, we feel warm.

When it is said that the blood circulates in the skin, it is not meant that it comes into quite the outside skin, but into the layer of skin that lies just beneath. The outside skin, which is that which rises in blisters, has no feeling in it and no blood-vessels. It is the covering of the body, and protects the parts underneath from injury. If it were not for this skin, we should feel pain every time we were touched ; for the layer of skin that lies just beneath it has a great deal of feeling in it,—as you know by the smarting whenever it is cut or pricked, or the outside skin is removed from it. This underneath skin is called the *true* skin, and it is in this that the blood circulates. Indeed it is so crowded with blood-vessels that you cannot prick it anywhere without pricking a vein and making it bleed.

One of the chief uses of this *true* skin is to help the blood to clear away out of the body the waste matter that is done with.

As you remember, the blood gathers up this waste matter as it runs along. It carries part of it to the lungs, where it unites with oxygen, and is then breathed out in the form of impure air and moisture ; and it carries part to the skin, where it goes out in perspiration, which is composed of water and a greasy sort of animal matter.

At the very least, a pound and a quarter of this waste matter has to be cleared away from the body through the skin every day.

Now when the skin is chilled by exposure to cold, all this quantity of hurtful and useless matter is driven inwards, instead of coming out through the skin, because the blood has been prevented bringing it to the skin owing to the shrinking of the blood-vessels.

It is no wonder, therefore, that taking cold often makes us very ill ; for if the skin does not do its share in the work of clearing off the waste matter, some other part of the body has too much work to do, and becomes inflamed and diseased in consequence. Thus, exposure to cold will sometimes throw this hurtful matter upon the liver, then it causes liver-complaint ; sometimes upon the bowels, and then there is bowel-complaint, but most often it is thrown upon the lungs, and then there is a bad cold or inflammation of the chest.

It is therefore always dangerous for the perspiration to be stopped or checked. As was shown in one of the first lessons, the perspiration is stopped by dirt being left on the skin, and so clogging up the skin that the perspiration cannot pass through it freely. And so much illness in this country is caused by the perspiration being checked from cold, that it will be useful to understand clearly what is most likely to give us cold, and when we are most likely to take it.

People do not often take cold when they are moving about quickly, because the blood is then flowing so vigorously that it can resist the chill ; they are most likely to take cold when they are sitting or standing

still, and when they have become chilly and their circulation feeble, or else over-heated and tired. Thus, a hurricane of cold wind blowing against us when we are walking briskly out of doors will not be so likely to give us cold as a little draught of air coming in through a door or window partly open, when we are sitting still in the house.

For the same reason, we may get wet through to the skin without its doing us any harm, so long as we are walking or running fast; but if we come and sit down in our wet things, a chill will strike us as soon as the glow and warmth from the exercise go off; and unless we are very strong indeed, we shall catch cold or perhaps be ill in a worse way.

Damp clothes, and wet shoes and boots, should be taken off when we come home, and dry ones put on; and if we have not dry ones to put on, we had better go to bed while some kind person dries our clothes for us, than sit in our wet ones.

Some persons are terribly afraid of cold water, and fancy that a cold bath would be sure to give them cold. But a cold bath can never give us cold if we plunge in when we are warm and in good health, and come out again almost directly, and dry ourselves quickly. The glow and warmth that then comes into the skin shows the good it has done. But if we get into a cold bath when we are cold and chilly, as some children do who stand shivering because they are afraid to jump in at once; or if we stay in the water

so long that we get chilly; then the bath is likely enough to do us more harm than good.

Sudden exposure to cold water or cold air does us no harm if we are warm and well beforehand; but makes us all the warmer and better afterwards. It is long-continued cold that drives the blood inwards from the surface, and gives us cold, and perhaps causes illness, if we are not very strong and healthy. If we are strong and healthy there is nothing that helps better to keep us so than regular washing all over in cold water, or cold bathing in the warm weather, if it is always done quickly and care is taken to dry and rub the skin well afterwards.

But those who have the care of infants and young children should remember that what is good for strong, grown-up persons, is not always good for them; and that their little bodies cannot bear the cold that older persons can. The younger the child is, the less it has power to resist the cold. Most mothers know that they must keep their babies warm, but some have a notion that it makes a child strong, and *hardens* it, to bathe or wash it in cold water, and to expose it to the cold air.

This is a great mistake; and many an infant gets a cold in the head or a complaint of the lungs from being carried out of doors in cold weather with its head uncovered, and with not enough clothes on to keep it warm. The little baby wants plenty of fresh, pure air for its lungs as well as we do, or even more than we do; and it wants plenty of washing to keep

its skin healthy ; but its feeble body should be well wrapped up and protected from the cold, and its tender skin should always have the comfort of warm water to be washed in, especially in winter time.

- Q.** What happens when we take cold ?
- A.** The waste matter that ought to come out through the skin is driven inwards, and causes inflammation and disease.
- Q.** When is the Perspiration most likely to be checked and driven inwards ?
- A.** When the blood is not circulating fast and vigorously ; that is, when we have been sitting or standing still a long time.
- Q.** What is the best way to prevent taking cold ?
- A.** To keep the skin healthy by plenty of washing and rubbing ; and to keep the circulation of the blood active by plenty of exercise and fresh air.

LESSON 26.

MISCHIEF OF TIGHT CLOTHING.

A FEW years ago there was an account in the newspapers of a young girl who suddenly fell down dead after eating her dinner ; and the doctor, who was called in, found that she had killed herself by lacing her stays too tight.

This is not the only poor girl who has shortened her days from the foolish idea that a small waist looks pretty, and because she does not think or does not know *what* it is that she is crushing and squeezing when she pulls the lace tighter and tighter.

We wonder and laugh at the folly of the Chinese

women who force their feet into shoes so small that the foot has no room to grow, and becomes in time an ugly little stump that is of hardly any use to walk with. If we were to see the Chinese ladies hobbling along on their poor crippled feet, we should think to ourselves, " Is it possible that anybody can admire what is so very ugly ; and that women can submit to spoil their feet and torture themselves in this way, just because it is the fashion to do it ! "

But in our own country we may find hundreds of young women who cramp and cripple parts of their bodies that are much more important than the feet ; who make themselves gasp and pant for breath whenever they run fast ; who make themselves liable to fainting-fits and diseases of the chest that may bring them to their grave ; and all for what ? Why, that they may make their waists look a little narrower than nature made them !

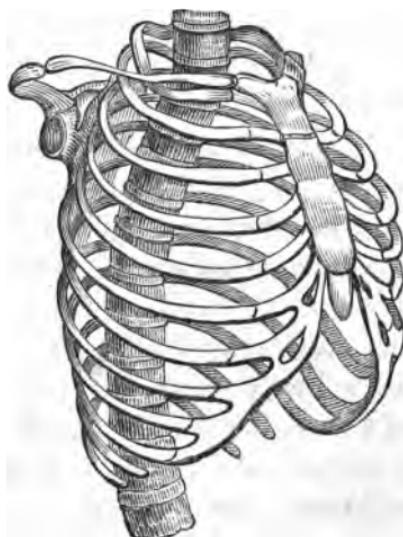
The Chinese women are guilty of no such folly as this ; no, nor even the poor savage who thrusts rings through his nose and ears, and pricks his body all over, that he may cover it with pretty patterns.

Look at the picture of the inside of the human body at page 12, and see where the heart and lungs lie ; how beautifully they are packed, so as to fit close into the place made for them, and yet so as to have plenty of room for all the motion they require. The beating heart, hanging loosely in its soft protecting bag, lies between the two lungs, and yet has room to expand and contract just enough to receive and send out the

blood ; the breathing lungs have just room enough to stretch out and take in the quantity of air that is needed to make the blood healthy.

The least pressure upon the heart will cramp its motions ; the least pressure upon the lungs will close up some of the air-cells, so that they cannot take in enough air.

To guard these tender parts from pressure that would injure them, a strong, bony case has been made to cover them ; fitting over them exactly with ~~its~~ smooth, rounded ribs, and yet made to move upwards and so to widen the space inside every time the heart and lungs expand, in such a manner that the bones may never press upon them.



BONES OF THE CHEST.

Now think of this beautiful contrivance for keeping safe from injury those parts on which our life depends, and then think of women actually making close-fitting cases of stiff cloth, whalebone, and steel, and strapping them over their heart and lungs every day so tightly that in time the protecting ribs are bent out of shape, and made to grow in upon the soft parts beneath !

It is easy to see what must happen from monstrous folly like this. The lungs become gradually smaller and weaker from the constant pressure upon them ; and so cannot take in air enough to make the blood healthy. The blood circulates feebly and cannot give the support and life to the body that it ought. The health is thus weakened, and the body made liable to disease ; and very likely if a common cold is caught that would not signify much to a strong person, the poor squeezed-up lungs are not able to bear up against it, and the fatal disease of the lungs called Consumption may follow.

A girl would think herself very cruelly treated if she were shut up in a place where there was not air enough for her to breathe ; where she would have to pant and gasp for air. But she treats herself quite as cruelly when she shuts up part of her lungs by the tightness of her dress, so that enough air cannot get into them.

It is found that a man can only breathe in two-thirds as much air when he is dressed as when he is naked. Now if a man's dress, which is made so

loose, deprives the lungs of so much air, how much air must a woman's tight stays keep out of her lungs ?

Clothing is much warmer in winter, and cooler in summer, when it fits so easily that the body is not cramped in any way by it ; and sensible persons know that there is much more grace and beauty in a natural shape, and the free use of the limbs, than in the distorted, squeezed-up waist, the high shoulders, and the stiff and awkward movements that steel and whalebone produce.

Q. When is Clothing too tight ?

A. When it prevents the Lungs stretching to their natural extent every time we breathe, and when it hinders the free circulation of the Blood.

LESSON 27.

DISEASE OF THE BODY OFTEN CAUSES DISEASE OF THE MIND.

Most children find that they can do their lessons best when they first come into school in the morning, fresh from the walk from home in the open air ; and most children feel more inclined to go to school after they have had a good night's sleep and a good breakfast, than if they have not slept well, and have had to come to school hungry.

This shows that what has done the body good, has also done the *thinking* part good.

This thinking part is, in some way that we do not understand, connected with a whitish, soft substance that lies in a hard round case made exactly to hold it, and keep it safe from injury. This substance is called the Brain, and it is the Skull that holds it; and in man it is placed at the top of the body as if to show that it is the noblest part. Use it right, and this thinking-part makes us far above the other animals; use it wrong, and it makes us far below them.

BRAIN. AND PART OF THE SPINE.



a Brain.
B Spinal Marrow.

Not only do we think with the brain, but we *feel* also with it. If the brain is stupified, there is no feeling in any part of the body. Cuts, pricks, wounds of any sort, would give us no pain, if the brain were not awake.

To give the sense of feeling wherever it is wanted, there branch out from the brain cords or fibres of a soft whitish substance called nerves, which like the wires of the telegraph, carry the messages of the brain to the different parts, and carry back to the brain information of all that is going on.

Thus, if we wish to move our arm, the brain sends this wish through the nerves that go into the arm, and the arm moves as it is bid. If the nerves in the arm were cut through, no wish of the brain could move the arm, any more than the telegraph could send messages if the wires were broken. The arm *below* where the nerves were cut would have no feeling in it and no power to move, because the nerve that connects it with the brain has been divided.

If something has hurt us in any part, the nerve in the part that is injured carries the sense of the injury to the brain, and this makes us conscious of pain in the part. If the nerves were cut between the wounded part and the brain, we should feel no pain from the wound.

You have heard of people becoming paralytic, and losing the use of their limbs from palsy. This happens when the brain or nerves are so diseased or injured that they cannot communicate with each other.

The main trunk of the nerves is called the Spinal-marrow, because it lies inside the spine or backbone. As you see in the picture, it proceeds from the Brain. Through holes in the backbone this great

nerve branches out into smaller nerves ; and in whatever part of the body most feeling is wanted, there are found most nerves.

Although we do not know how it is that the mind thinks by means of the brain, we do know that the mind cannot think well unless the brain be healthy, and that the brain is in a great measure kept healthy and fit for use by the same means that other parts of the body are kept healthy ; that is, by pure blood circulating in it, by exercise, and by rest.

When we are obliged to breathe bad air in close or crowded rooms, we soon feel the ill effects of it in the brain. The head begins to ache or to be dull and drowsy, and thinking seems hard work. If the air becomes very impure indeed, faintness may come on and the brain can think no longer. Thus we often hear of women being carried out fainting and unconscious from crowded Theatres or Lecture-rooms or Chapels, especially if they have tight stays on that prevent their lungs taking in what little oxygen there may be in the air. Directly these fainting persons are carried out into the open air, and their dress is loosened, their brain begins to think and be conscious again, because the fresh air directly supplies the blood with enough oxygen to restore the brain to health.

But if persons constantly live in rooms where the air is unwholesome, and where the brain is therefore seldom or never supplied with healthy blood, lasting injury must be done to it. Nervous complaints will

most likely come on, especially in women, and then they become weak-headed and timid, liable to bad head-aches or fits of various kinds, or unable to control their feelings or their temper.

The same sort of mischief is done when the blood that goes to the brain has not enough nourishment in it. Thus people who have not food enough to eat often suffer from nervous diseases; and low spirits often come from indigestion; that is, from eating unwholesome food. In both cases there has not been chyle or nourishment enough mixed with the blood to make it fit to feed the brain properly.

When we see how often the peace and comfort of a whole family are destroyed by one fretful, nervous person in it, we need not be told how much it is our duty to keep our brains healthy by all the means in our power.

See how the uncontrolled temper of one in a family spreads like an infectious disease to everybody in the house!

Perhaps there is the poor mother who is really suffering from nervous weakness, and who cannot keep her temper when the children are troublesome. She beats or scolds them instead of correcting them gently; this rouses the children's ill-temper, and then they beat and scold one another, until everything goes wrong, because the spirit of Love has been turned out and the spirit of Discord has been let in.

Or perhaps there is a drunken father at the head of

the family, who has so weakened and besotted his brain with drink, ~~that~~ he has no control at all over his temper and passions. He ill-treats and abuses his poor wife until her temper is roused and she abuses him in her turn. The children do as they see their father and mother do ; and so the home is made a scene of strife and misery instead of being one of peace and love and comfort.

Of course a weak mind and a bad temper do not always come from ill-health. Some are born with weaker minds than others ; some have never been taught to govern their tempers ; some are so selfish that they do not care how much pain they give others by their peevishness or passion ; but those who wish to do what is right, and to make all about them cheerful and happy, will try to keep themselves strong enough in body and mind to have their temper and feelings always under good control.

The Brain needs exercise like every other part of the body. Our legs and arms would not grow strong if we never used them, neither will our brain grow strong if we never give it any regular work to do.

Going to school is not only useful for what is learned there, but for getting the brain into a good habit of thinking in right earnest, so that it may grow strong and active and able to tell us what is right to be done, and how to do things in the best way all our lives long.

A gentleman once asked a little country-boy who

was idling about in the fields "What he was thinking about?" "Mostly nought, Master," said the little boy. There is an old proverb that "Nought comes from Nought," and it is certain this little fellow could not come to much good, if he went on all through his life thinking about "mostly nothing."

Those persons who have the care of Asylums for Idiots tell us that a great many idiots come from country places where the children have no schools to go to, and who idle about all day long, and whose work when they grow up does not require them to use their brains much; but they say that very few idiots are found in those places where the children are well employed, where their minds are educated, and where they are put to those kinds of work in which their heads as well as their hands are obliged to be busy.

The best use of the thinking faculty is to put thought and good sense into everything that we have to do. A woman may know how to read and write, and may be very clever at fancy-work; and yet she may be thoughtless and ignorant about everything that makes a home comfortable.

A man may be a very clever fellow, and may know how to do a hundred ingenious things; may read a great many books and newspapers; may make fine speeches at public meetings, and understand all the affairs of the nation; and yet he may manage his own affairs very badly, and bring his family to trouble, because he does not use his brains in the right way where they are most wanted.

Those who are poor, and are obliged to make a little go a great way, have much more need to be clever at managing their households than the rich, who have plenty of everything. A woman who knows how to make the best of everything ; how to buy the cheapest and yet the most wholesome food ; how to cook it in the best way, and yet with the least waste ; how to keep her house and her children clean, and to keep everything in its right place ; how to teach her children to be useful in such a kind, sensible way that she makes them love to do as they are told ;—such a woman, if she is ever so poor, will make a home pleasant and comfortable.

Let us look at this picture of a poor man's home in Liverpool, and see what a good wife can do who sets her mind to think how she can make her home happy. "If we look now at a truly happy home amongst the working classes,—and, thank God, there are some left,—what do we see ? The wife clean and orderly in person, her house the same. The mind of the wife is distinctly visible in the character of the dwelling. The husband is a carter, in the employ of a Railway Company. As meal-time approaches, and the rough-looking, toil-begrimed man opens the door, the wife's cheerful smile seems to lift a load from his heart. His children have been taught to look with pleasure and to clap hands for daddy's return, and have flattened their little noses against the window in their anxiety to announce his coming, and the

meeting is indeed cheering to all. If the man is wet, a change of clothes is ready for him, his slippers are by the fire, and a clean pair of stockings hanging on the oven-door. She thought it might be wet, so was determined to keep up a good fire. If he has met with any trouble, had a hard day, or a very dirty and unpleasant job, and is inclined to growl, his wife is ready with her sympathy and consolation, and the cheering words, 'Never mind!' Then the meal,—suppose it tea,—who can picture the delights of a cosy tea, such as will be found here?—the table neatly laid out,—the repast comfortable and inviting. And the wife will have much to tell him,—what she has been doing, what the chidren have done and said, who called to see her, and how pleasant it was to hear about old friends, all of which has a tendency to make the man forget care and sorrow. If men were all treated in this way—if their presence at home was prepared for and enjoyed; if their troubles were chased away by the sunshine of home,—think you the ale-house would have so many victims,—think you the publican could erect such extensive beggar-making establishments?"*

Look from this cottage into another, where the wife had never learned how to do those things that are most wanted to make a home comfortable. When she was young, the training which she might and ought to have received at home she neglected that she might

* Abridged from "Town Life."—*Tweedie and Son.*

go to a dancing-class, and she dressed herself in tawdry finery instead of neat and proper clothes. "She had never been taught or compelled to keep even her own bed-room in a clean, tidy manner ; what, therefore, might be expected when she had to keep her husband's house. Just what you saw. Everything in disorder—tea-cups, unwashed, on chairs ; the tea-tray thrown on the bed ; towels, dirty and clean, thrust into a bandbox ; dabs of grease, crumbs, or crusts of bread, scattered on the floor, or garnishing every article of furniture ; the ashes heaped up to the bars of the grate, the tongs split in two, and the poker bent with breaking lumps of coal or knocking nails in. Uncleanliness of all sorts was apparent throughout this home ; and there she sat," a dragglety young woman, "in the midst of it."

We are told that this wife and her husband, while they were still young, both took to drinking, and soon sank into the depth of poverty.

The time to learn, and to form habits is when we are young. All who are brought up to any trade have to begin their apprenticeship at it before they have done growing ; while their limbs and muscles are young and pliable. The weaver, the sempstress, the carpenter, the musician, would find it hard work to teach their fingers late in life to bend about in the way that each of their trades require.

It is the same with the brain, which goes on growing up to a certain age and seldom alters much afterwards.

It depends therefore very much upon *how* we use our brain in youth, what will be our *power* of using it in after life. When we are young we can learn more easily and quickly than when the brain is fixed and formed ; and if we begin life by following only our inclinations and passions, instead of early using our reason to guide our actions, it is likely enough that when the difficulties and troubles of life come, and we want a clear, strong head of our own to help us through them, we shall sink under them, as that poor Liverpool woman did, just for the want of the training that we neglected in our youth.

A girl who spends all the time that she has for improving her mind and learning useful things in reading foolish books, or in making up tawdry finery, or in dancing-classes, or in keeping company with those who only lead her into folly, will find when she grows to be a woman,—perhaps a wife and mother,—that she cannot easily turn her mind to what she feels then that she ought to know.

If boys and girls could but see beforehand how much trouble may come to them in after-life from want of thought and want of knowledge, they would only be too anxious to lose no time in setting their minds to work on all that is really useful.

There is not much need to tell most young people that their brain needs rest as well as exercise; since they are seldom inclined to study too hard, and they are mostly fond enough of their beds to give their heads plenty of rest every night.

But it is as well that all should know that there is a time in the day when the brain should not be worked hard ; and that time is, just after a hearty meal.

The brain and the stomach can never be hard at work at the same time without injuring each other. If the stomach is busy digesting, the brain ought not to be very busy thinking. The reason is, that wherever there is special work to be done, the brain immediately sends nervous power to that part, and the blood flows into it in an unusual quantity to give the strength that is wanted to do it.

Thus the instant the food is swallowed, the stomach receives additional nervous energy, and the blood flows faster into its blood-vessels to help it to digest, and to keep up its warmth and activity till digestion is done ; and there is therefore less blood and nervous activity in the brain and other parts of the body, during digestion. We feel drowsy and chilly after a full meal, because the blood and nervous energy have been taken from the brain and other parts to go to the stomach.

But if the brain sets to work hard just as the stomach is digesting, the blood rushes fast into the brain and leaves the stomach with too little blood. This stops the digestion, and makes all go wrong with the stomach and the parts connected with it.

We know how any sudden bad news, or anything that excites the brain very much while we are eating, will take away our appetite and prevent our digestion.

This is partly nervous and partly because the blood has suddenly rushed to the brain, and left the stomach. And those who hurry away to hard work or hard study just after their dinner, almost always suffer from indigestion. If, therefore, there is a little time for rest in the day-time, it is better that it should be just after the best meal of the day.

- Q. Why is it especially our duty to try and keep the brain healthy?
- A. Because an unhealthy brain often causes those nervous complaints and defects in the temper which give great discomfort to others besides ourselves.
- Q. What helps to keep the brain healthy?
- A. Plenty of fresh air, exercise of both body and brain, and wholesome food.
- Q. How does Education help to make the brain healthy?
- A. It makes it grow strong and active, by giving it regular work to do.
- Q. When is the best time to get knowledge and to form good habits of thought?
- A. While we are young, and before the brain has done growing.
- Q. At what time in the day should the brain *not* be working hard?
- A. Just after a good meal, while digestion is going on.

CONCLUSION.

WHEN we think of all the movements of this wonderful machine, the human body,—of all that is constantly going on inside us, whether we wake or sleep, whether

we rest or move, whether we think upon it or not,—we can hardly help feeling that there must be some hidden power within us that directs each motion and that every instant provides for our safety.

We lie down each night to sleep, and have no fear lest the heart should cease to beat, or the lungs to breathe, during the hours of our unconsciousness. And yet we know not what it is that causes the heart to beat and the lungs to breathe.

We eat and satisfy our hunger, and think no more about it ; and thousands and thousands of people eat and satisfy themselves without even knowing how it is that the food feeds them.

They little think of the manufactory inside them that is necessary to make blood out of food—far more curious than the manufactory that makes gas from coals, paper from rags, or sugar from the juice of a plant.

They little think that their life and the health and comfort of each moment depend upon little doors or valves opening and shutting at the right time ; for instance, upon the wind-pipe valve, that prevents the food going down the wrong way; upon the stomach valve, that prevents the undigested food from going into the intestine ; upon the valves in the heart and veins which keep the blood in its right course, and prevent its flowing backwards.

We breathe in the air every instant, and feel that we should die if we did not ; but very few of us know

why we breathe, and what it is in the invisible air that sustains the life and warmth of the body.

What would become of us if it depended upon ourselves to direct all these movements within us?—if the heart waited for us to make it beat; or if the lungs ceased to breathe if we forgot to stretch them wide to receive the air?

Try and move your arm backwards and forwards, without stopping, as fast as your heart beats—70 times a minute—and see how soon it will begin to ache and grow tired and you will be obliged to leave off; and yet the heart, although it is made of the same kind of substance as the muscle that moves in the arm, never tires day or night.

It is left to ourselves to move our limbs as we please, because life does not depend upon their motions; but if we had to guide the motions of those parts on which life does depend, would life itself have any value for us? Could we turn our thoughts for a moment to anything else?—Could we help one another, or do the work that it is our duty to do, or enjoy the blessings that are given us to enjoy?

And yet what is this wonderful hidden power that keeps all in motion?

We call it LIFE; but we cannot tell what life is; we only know that it is the gift of God, and that “in Him we live and move and have our being.”

It has not been left to ourselves to make this living machine go, any more than the watchmaker leaves it

